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May 1951

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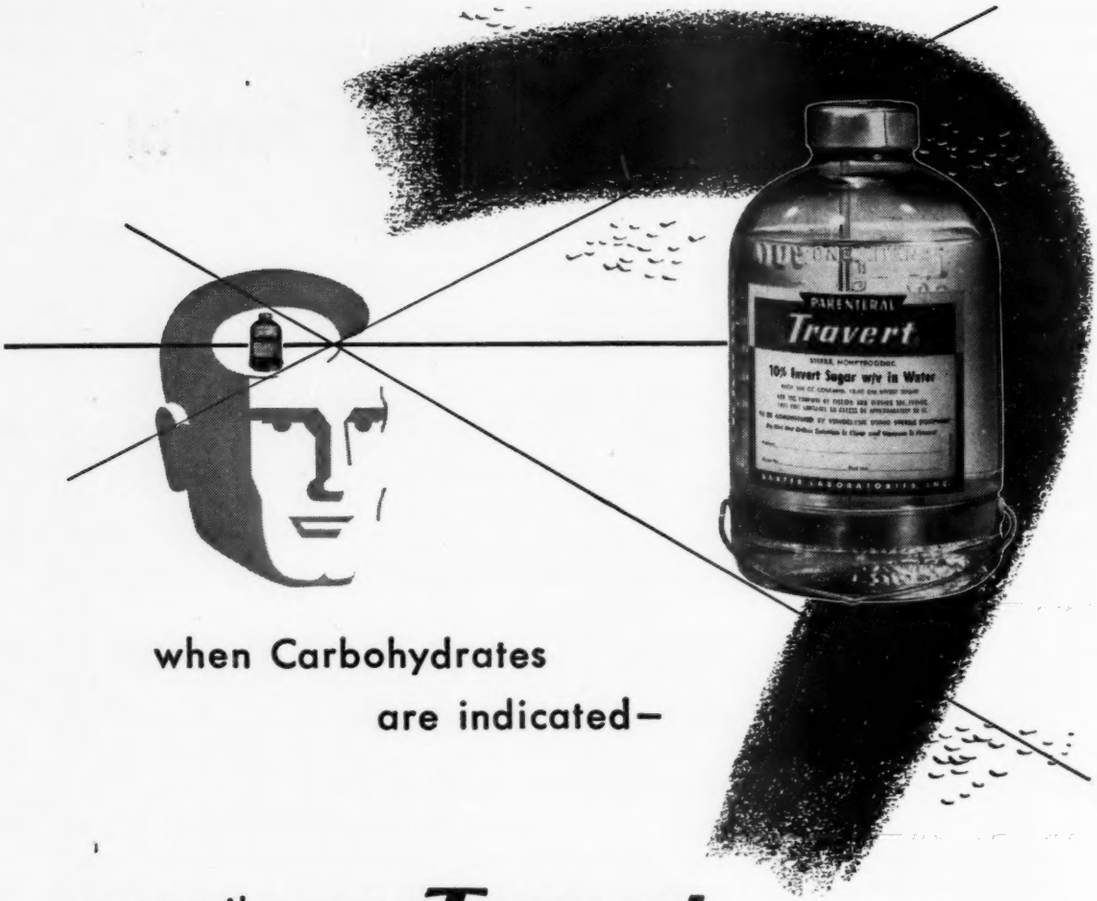

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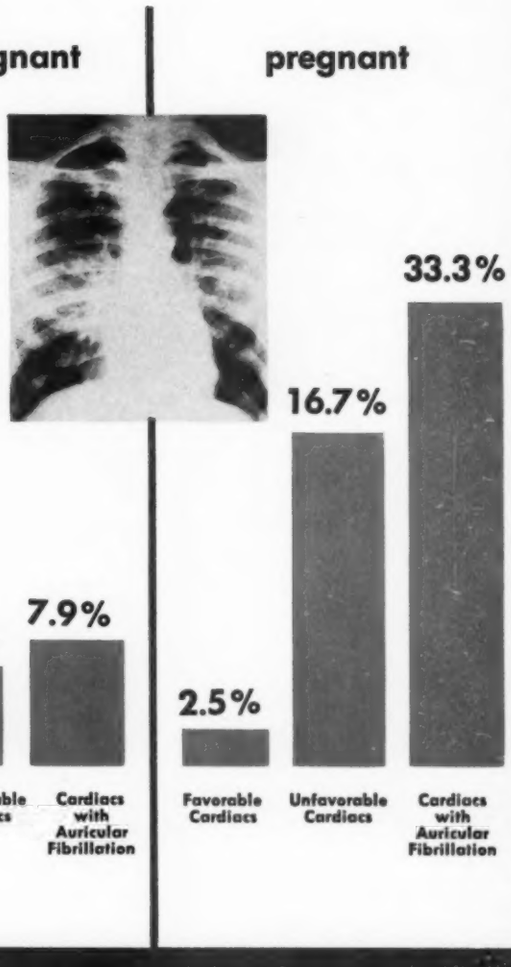

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* Hamilton, S. E., and Thompson, K. J.: The Heart in Pregnancy and the Childbearing Age, Boston, Little, Brown & Co., 1941, p. 98.

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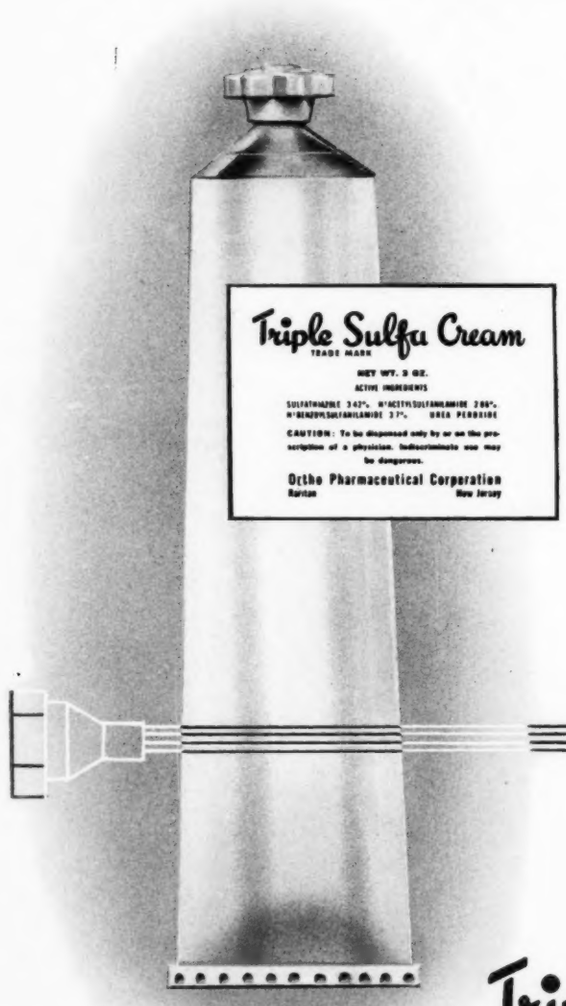
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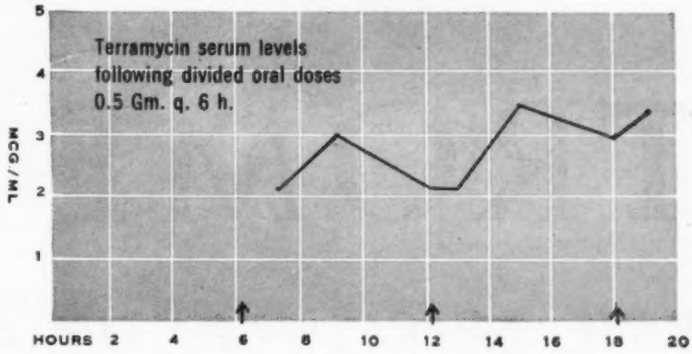

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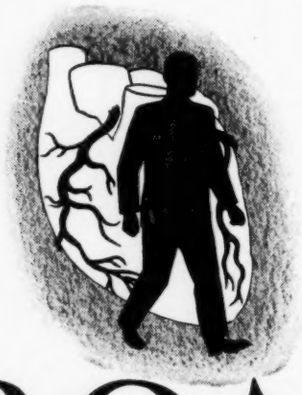

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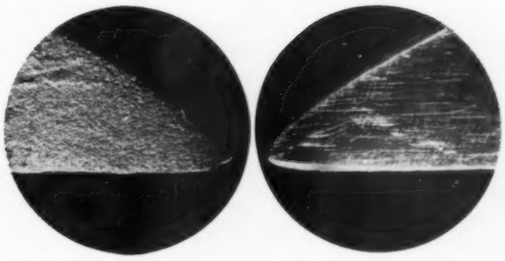

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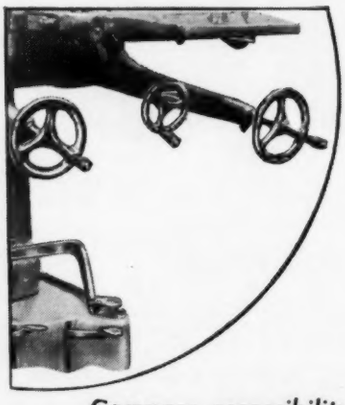

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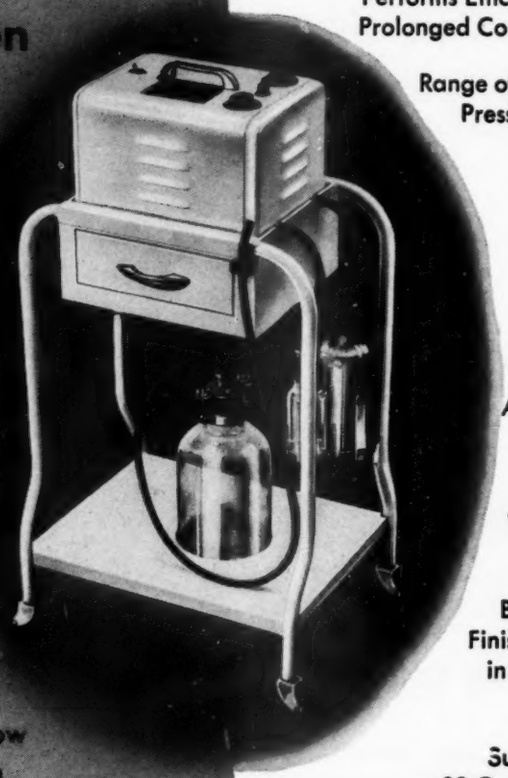

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The versatile and dependable performance of this essential unit, perfected after several years of research, fulfills the ever-present demand for these clinical requirements.

FEATURES

Pilot Light — Intermittent "On and Off" — Constant Visual Performance Check.

Performs Efficiently During Prolonged Continuous Use.

Range of Suction and Pressure Minutely Controlled.

Suction Calibrated from 50 to 250 cm. Water.

Motor Unit Automatically Ventilated.

Noiseless—Vibrationless.

Sklar Ivory-Baked Enamel Finish—Attractive in Appearance.

Gallon Size Suction Bottle—32 Ounce Irrigating Bottle—Trap Bottle.

Mobile—Stand Mounted on Casters.

No Maintenance or Lubrication Required.

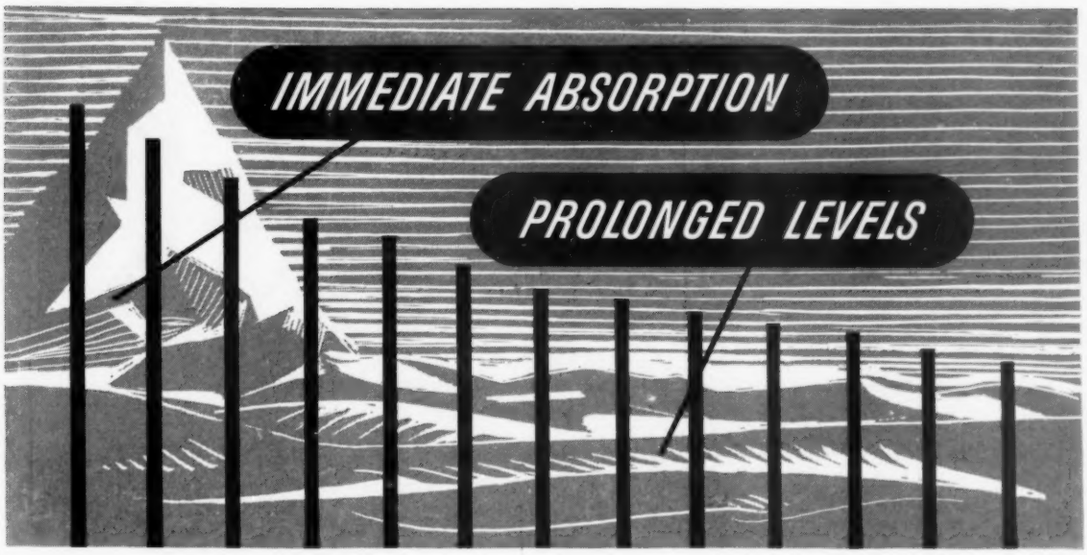
TWO YEAR GUARANTEE

Available through accredited surgical supply distributors.

Sklar LONG ISLAND CITY, N. Y.

SURGICAL INSTRUMENTS . . . SUCTION PRESSURE AND ANESTHESIA APPARATUS . . . RESEARCH AND DEVELOPMENT

A SKLAR PRODUCT



FROM A SINGLE INJECTION OF

Bi-Pen®

Bi-Pen—crystalline procaine penicillin G and buffered crystalline penicillin G potassium—is an outstanding preparation for day-in and day-out use in the treatment of many infectious diseases. Containing 400,000 units per cc. when suspended in water, it provides 100,000 units of potassium penicillin G and 300,000 units of procaine penicillin G per dose. Note these desirable features:

High Initial Levels. Rapid absorption of the soluble crystalline potassium penicillin leads to high initial plasma levels for prompt therapeutic effect.

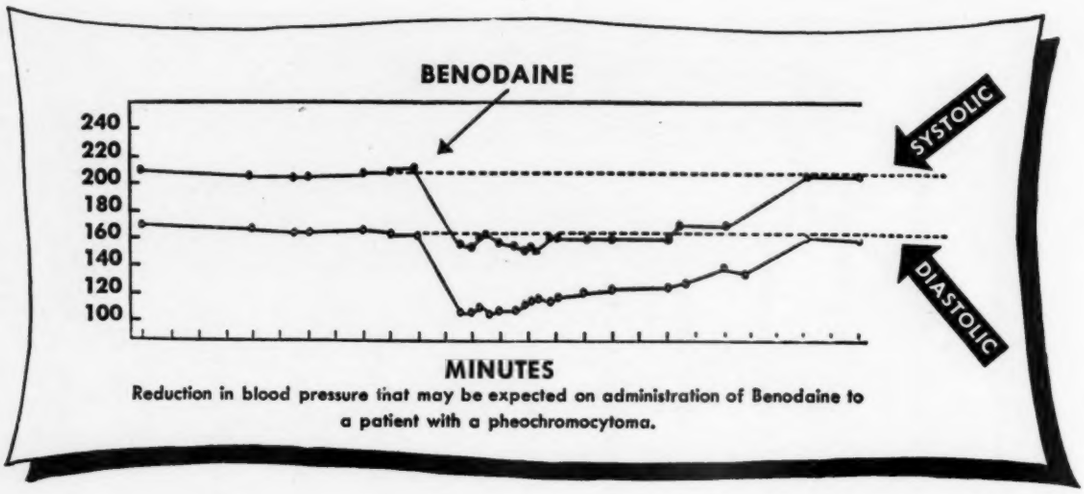
Prolonged Levels. Delayed absorption of the procaine penicillin depot gives demonstrable blood levels for 24 hours in most patients from a single 1 cc. injection daily. 2 cc. may be given at one time if required.

Easy to Prepare. The addition of 4.2 cc. of Water for Injection to the contents of the 5 dose vial produces 5 cc. of prepared Bi-Pen which is free-flowing and is readily aspirated and injected through a 20-gauge needle.

Supply. Bi-Pen is supplied in three package sizes for utmost flexibility of use: (1) 5 dose vial; (2) single dose vials in individual boxes; (3) single dose vials in boxes of 50.

C.S.C. Pharmaceuticals

A DIVISION OF COMMERCIAL SOLVENTS CORPORATION • 17 E. 42nd STREET, NEW YORK 17, N. Y.



Reduction in blood pressure that may be expected on administration of Benodaine to a patient with a pheochromocytoma.

A test to detect

Hypertension-Producing Pheochromocytomas

Many physicians are making routine diagnostic tests in hypertensive patients, with intravenously administered Benodaine.® Quickly, this test indicates whether or not the high blood pressure is caused by an epinephrine-producing tumor (pheochromocytoma).

In patients with hypertension caused by a pheochromocytoma, Benodaine produces a brief but significant *decrease* in blood pressure. In hypertensive patients who do not have this tumor, it produces either no significant change in blood pressure or a moderate elevation of short duration.

Complete literature available on request.

Saline Solution of **BENODAINE®** HYDROCHLORIDE

(Brand of Piperoxan Hydrochloride)

(2-(1-Piperidylmethyl)-1,4-Benzodioxan Hydrochloride Merck)

Benodaine is the registered trade-mark of Merck & Co., Inc. for its brand of piperoxan.

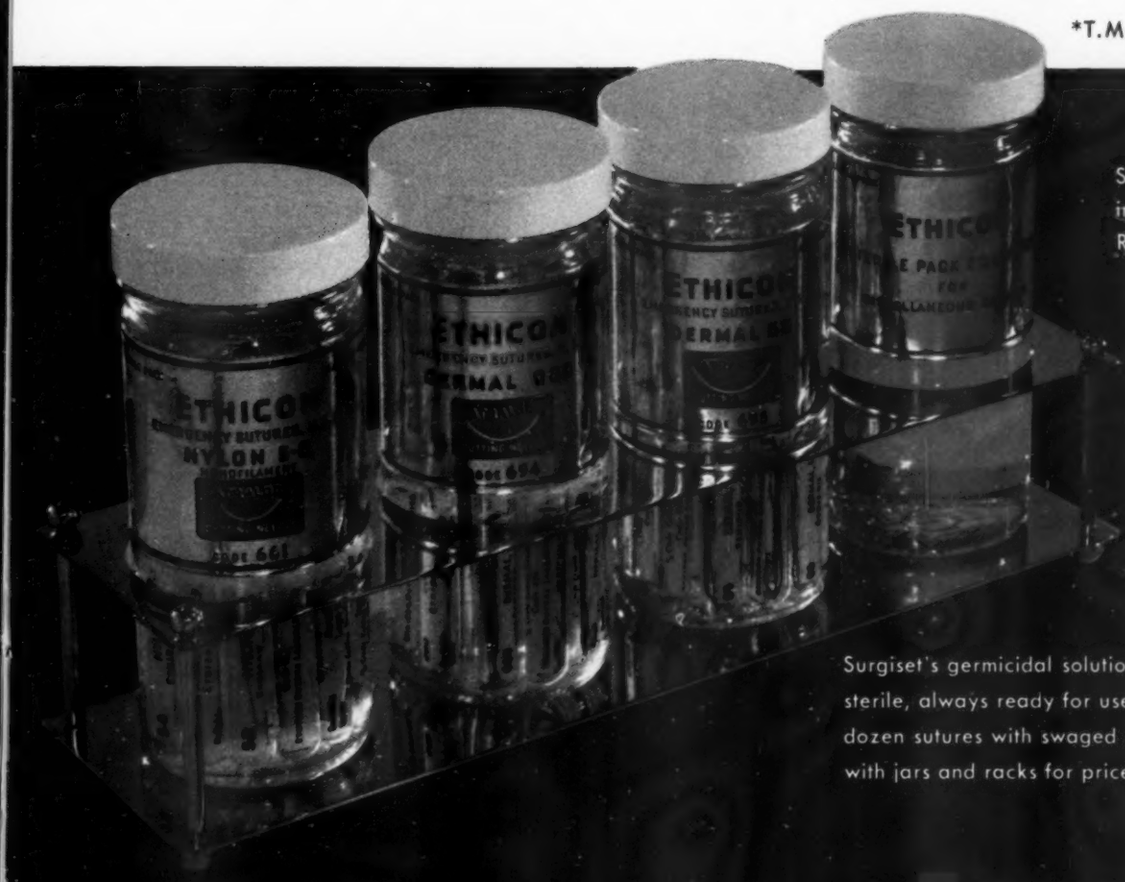
MERCK & CO., INC.
Manufacturing Chemists
RAHWAY, NEW JERSEY

*The Surgiset**

SKIN CLOSURE SUTURES

fills a real need in emergencies... ...particularly today!

*T.M.



Suture Assortment (3 sizes) in Sterile Pack Jars, Ready to Use.

Surgiset's germicidal solution keeps suture tubes sterile, always ready for use. Surgiset contains 3 dozen sutures with swaged Atraloc needles. Complete with jars and racks for price of sutures alone.

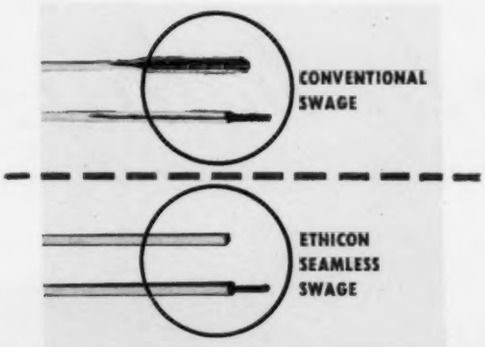
ETHICON®

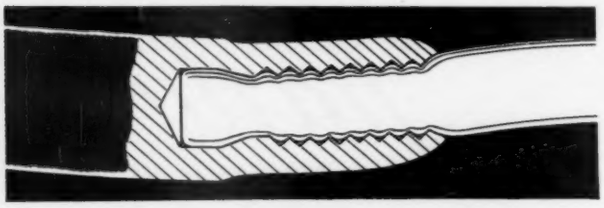
EXCLUSIVE

One temper throughout-
no soft spots or brittleness

ATRALOC®

Seamless Needles





Cross-section of swaged end of Ethicon Seamless Needle. End is drilled and threaded. Suture is screwed in position. Needle is cold-pressed to establish absolute grip on suture.

GREATER STRENGTH

LESS BULK FROM EVEN-TEMPERED STEEL

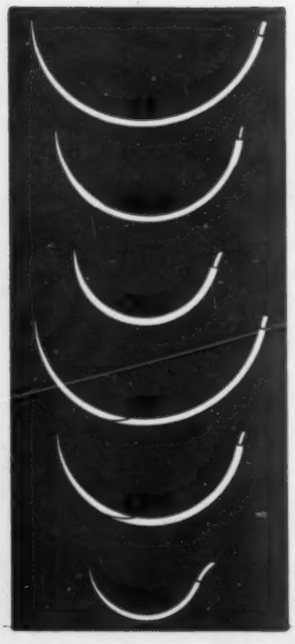
Surgeons are offered new refinements and dependability in use in the Ethicon Seamless Swaged Needles.

Their exclusive design is based on a new construction principle, devised by Ethicon engineers and metallurgical consultants.

The surgeon gets a needle with an unbroken surface from end to end, without brittleness or soft spots. The process permits complete control of every stage of manufacturing. Uniform strength of the steel is maintained by the electrical method of tempering the needle. The result is a smaller diameter, yet stronger needle with optimum flexibility and maximum stiffness.

The shorter swage permits a longer, more useful flat area which also does not turn in the needle holder.

As the illustrations above show, the Ethicon Seamless Needle is free from the possibility of rough seams, often found in the conventionally swaged needle.



FOR ABDOMINAL CLOSURE

SIX NEW NEEDLES SERVE MOST ALL USES

For Ob., Gyn. and general closure, sutures swaged to eyeless needles are winning acceptance through their many benefits.

The Ethicon Seamless Needle draws a single strand of suture through the tissues, with minimal tissue trauma and added speed and ease of use. The Seamless Needles have uniform curvature and improved cutting points with constant sharpness. They are hand-honed and individually inspected. Fewer sizes and varieties are needed. Time of nurses is saved in release from threading and in preparation of sutures requested by the surgeon.

After extensive research in surgeons' preferences, Ethicon designed the 6 needles shown at the left, which meet the requirements for 80% of the needles used in abdominal closure.

These needles are swaged to Ethicon's Tru-Gauged, Tru-Chromicized Surgical Gut, noted for its strength and flexibility.

ETHICON SUTURE LABORATORIES

INCORPORATED

Suture Laboratories at New Brunswick, N. J.; Chicago, Ill.; Sao Paulo, Brazil; Sydney, Australia; Edinburgh, Scotland.

The Finest Adhesive Tape
sticks best and is easiest on the skin
RED CROSS
ADHESIVE
TAPE
Johnson & Johnson
New Exclusive Formula
now gives RED CROSS* Adhesive Tape
better "stick"
greater freedom from skin irritations
whiter appearance
and stays fresh longer
Johnson & Johnson
*No connection whatever with
the American National Red Cross

Because it contains 'Benzedrine' Sulfate . . .

'EDRISAL with CODEINE'

does far more than relieve pain following

surgery or childbirth

It relieves depression. The antidepressant activity of 'Benzedrine' Sulfate averts the all-too-familiar depressant effect of codeine. It actually lifts the patient's mood!

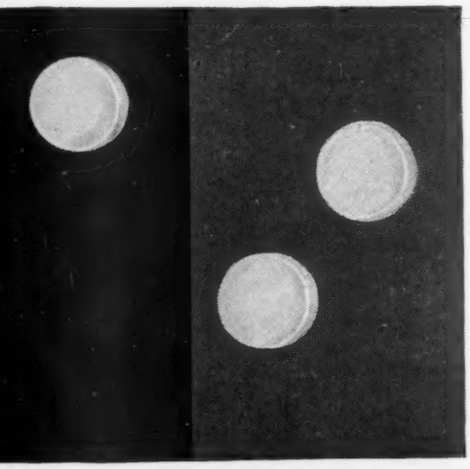
And, thus, encourages early ambulation. By improving the patient's mood, 'Benzedrine' creates a willingness to get out of bed.

DOSAGE: One or two tablets repeated every three hours if necessary. Only in exceptional cases will more than six to eight tablets be required in a 24-hour period. If disturbance of sleep should be encountered in the higher dosage ranges, this can easily be controlled with a mild sedative.

Each tablet contains:

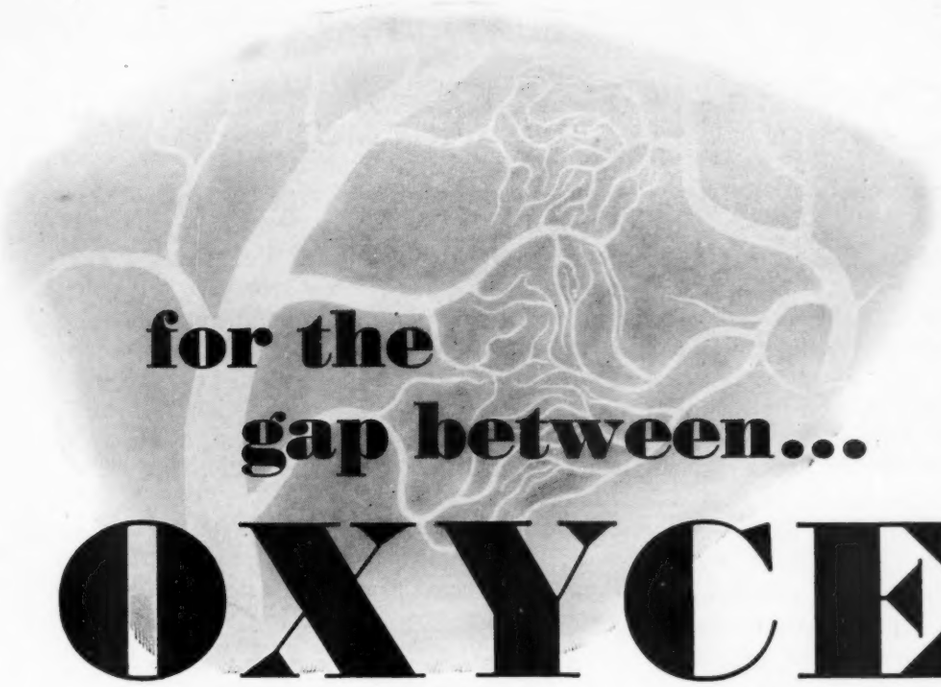
Codeine sulfate	¼ gr.
'Benzedrine' Sulfate	2.5 mg.
Acetylsalicylic acid	2.5 gr.
Phenacetin	2.5 gr.

Available in bottles of 50 tablets



Smith, Kline & French Laboratories, Philadelphia, Pa.

'Edrisal' & 'Benzedrine' T.M. Reg. U.S. Pat. Off.



for the gap between...

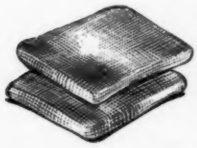
OXYCEL®

(OXIDIZED CELLULOSE)

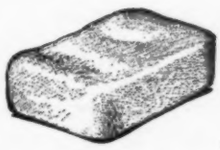
In the control of bleeding between arterial and venous systems, where vessel size precludes the use of hemostat and suture, OXYCEL—absorbable hemostatic—provides prompt control of capillary bleeding. Trauma is minimized, operative procedures shortened, and post-operative hemorrhage notably curtailed. OXYCEL is practical and convenient, too . . . applied direct from the container, it conforms readily to all wound surfaces.

Package Information:

Supplied in individual glass containers in the following convenient forms:

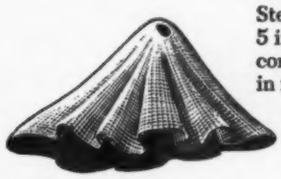


OXYCEL PADS:
Sterile, gauze-type,
3 inch x 3 inch
eight-ply pads,
and 4 inch x 12 inch
eight-ply pads.



OXYCEL PLEDGETS:
Sterile, cotton-type
2¼ inch x 1 inch x 1 inch portions.

OXYCEL STRIPS:
Sterile, four-ply
gauze-type strips
18 inch x 2 inch;
four-ply, 5 inch x ½ inch;
and four-ply 36 inch x ½ inch,
pleated in accordion fashion.



OXYCEL FOLEY CONES:
Sterile, four-ply, gauze-type discs,
5 inch and 7 inch diameters,
conveniently folded
in radially fluted form.

MEDICAMENTA VERA

PARKE, DAVIS & COMPANY

Outside the Ivory Tower

THE Helen Putnam fellowship for advanced research in genetics or mental health open to women scholars who have their doctorate will be offered by Radcliffe College for the academic year 1951 to 1952. The award carries a stipend of $2,800 a year with the possibility of renewal. Applicants are asked to submit a plan of research and preference will be given to those whose research is already in progress.

THE National Paraplegia Foundation wishes to announce the continuation of a limited number of fellowships for research in spinal cord disease and trauma and in the complications commonly associated with such disease or injury. These fellowships carry a minimum stipend of $3,000 per year and may be awarded to any candidate who has demonstrated a capacity for medical research and has outlined a program of meritorious study. The fellowships will be awarded by the Medical Advisory Committee and are open for award for the academic year 1951 to 1952. Application forms may be obtained from the Chairman of the Medical Advisory Committee, and applications should be submitted to him not later than June 1, 1951.

CATASTROPHIC accidents, those killing five or more persons, claimed nearly 1,500 lives in the United States in 1950, about 250 greater than in 1949, the statisticians of the Metropolitan Life Insurance Company report. The Thanksgiving weekend wind and snowstorm and the Thanksgiving eve wreck of the Long Island Railroad at Richmond Hill were the most costly in loss of life. The storm claimed about 100 lives and the wreck killed seventy-nine. Third as to death toll was the air transport accident in Lake Michigan last June which took fifty-eight lives—highest in civil aviation history in the United States. The total deaths in civil aviation catastrophes, however, was somewhat lower than in 1949.

THE 2,000,000th person to enroll in United Medical Service, New York's Blue Shield Plan, was honored at a dinner held January 25th at the Hotel Biltmore, New York City. Approximately 400 persons, including representatives of local, state and national medical societies, Blue Shield and Blue Cross Plans, and business organizations attended. A feature of the occasion was the presentation of an achievement award to Dr. Charles Gordon Heyd, president of United Medical Service on behalf of the non-profit, voluntary "doctors' plan" by Dr. Howard Schriver, president of the national Blue Shield Commission. Dr. Elmer L. Henderson, president of the American Medical Association, delivered the main address. His subject was "A New Milestone in Prepaid Medical Care." Dr. Carleton E. Wertz, president of the Medical Society of the State of New York, presided.

DR. Lewis H. Sarett of Merck & Co., Inc., the chemist who at the age of twenty-seven synthesized the anti-arthritis drug, cortisone, has been chosen to receive the Leo Hendrik Baekeland Award of the American Chemical Society's North Jersey Section for 1951, it was announced by Dr. George L. Royer, chairman of the Section and of the jury of award. Dr. Sarett was cited for his "outstanding achievement in creative chemistry," which gave new hope to millions of arthritis victims and which also made possible great progress in combatting rheumatic fever and several other diseases. The Baekeland Award, which consists of a gold medal and $1,000, is sponsored by the Bakelite Division, Union Carbide and Carbon Corporation, and is conferred biennially upon an American chemist under forty in recognition of accomplishments in pure or industrial chemistry. Presentation of the 1951 award to Dr. Sarett, who is now thirty-three, was made at a dinner meeting of the North Jersey Section in Newark.

MANY types of urinary tract infections can be effectively controlled by terramycin, newest of the broad range antibiotic drugs, according to a medical report published by three New York clinicians in the December, 1950, issue of "California Medicine." Terramycin was used in treating thirty-two obstetric and gynecologic patients with urinary tract infections in New York Hospital. "The results with terramycin were uniformly good in cases in which no organic or obstructive disease existed," said the doctors. Of thirty-two such

(continued on page 22)

The Surgeon's Mart

When you are in need of surgical instruments or medical supplies you will find the dealers and manufacturers listed below ready to serve you. For your guidance when purchasing supplies we submit this list.

SPECIALISTS

Plastic Instruments · Ear, Eye, Nose & Throat
Lempert Set · Orthopedic · Diagnostic

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DEPENDABLE QUALITY SERVICE

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COCHRANE PHYSICIANS' SUPPLIES, INC.
133 East 58th Street New York 22, N. Y.

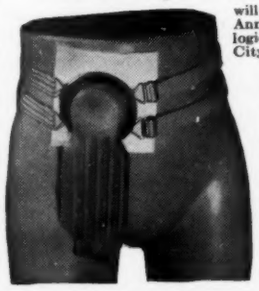
PRECISION-ENGINEERED SURGICAL INSTRUMENTS AND ORTHOPEDIC APPLIANCES

acme
engineering company, inc.

P. O. BOX 2279
GREENSBORO, NORTH CAROLINA

WRITE TODAY FOR FREE CATALOG

Colostomy & Ileostomy Appliances



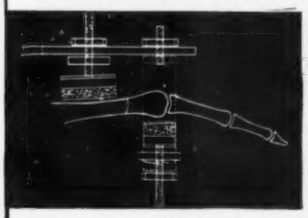
will be on display in June at: Fiftieth Annual Session of the American Proctologic Society Booth No. 33—Atlantic City Session of the A. M. A. Booth J-28

NEW 1950 MODEL

Convertible to use as Colostomy or Ileostomy appliance, Irrigator, or Protector. New unique method of cementing to the body (optional). Permits use of latex OR disposable plastic bags. *Write for folder showing complete line.*

MURLE PERRY
112 Hennepin Avenue
Minneapolis 1, Minn.

METACARPAL and THUMB FRACTURES



NEW TREATMENT NOW AVAILABLE

GOLDBERG METACARPAL SPLINT. A closed method of treating all types of Metacarpal Fractures including the Thumb.

Write for Literature and Reprints.

AMERICAN ORTHOPEDIC APPLIANCES
P. O. Box 31 Springfield, Mass.

Close-Up of Eye Taken with Kine Exakta "V" Camera.

For Parallax-Free Surgical Photography!

KINE EXAKTA "V"

35 mm Single Lens Reflex Camera

The Kine Exakta, with both regular and telephoto lenses, is widely used in hospitals for operation room photography. Its unique through-the-lens viewing system assures absolutely correct "on the subject" photographs during every step of the operation. In addition, this world famous medical camera is regularly used for preliminary, developmental, and end result pictures of patients; for copying X-Rays; and for making color transparencies of injuries and lesions —a necessity for recording and lecturing.

With f3.5 Zeiss Tessar "T" Coated Lens	$180.00*
Penta-Prism Eye Level Reflex Viewfinder	60.00*
Extension Tube Set	24.00
Microscope Adapter	29.50

* plus tax

Write Dept. 500 for free descriptive booklet "E" on camera and accessories and brochure on close-up technique with the Kine Exakta.

EXAKTA CAMERA CO., 46 W. 29th St., N. Y. 1, N. Y.
Exclusive Sales and Service Organization in the U.S.A. for Ihagee Camera Works, Germany

RADIUM
RADON

SEEDS — APPLICATORS

THE RADIUM EMANATION CORP.
GRAYBAR BUILDING, NEW YORK 17, N. Y.
MURRAY HILL 3-8636

Won't curl, twist or kink . . . and ties like silk.

Write Dept. M for liberal samples.

Only "CABLE WIRE"
the Multiple Strand Stainless Suture

Offers All These Advantages
- TIES LIKE SILK
- NON-CORROSIVE
- MINIMIZES SUTURE INFECTION
- EASY TO STERILIZE

United **SURGICAL SUPPLIES CO.**
160 E. 56th Street, New York 22

Outside the Ivory Tower

(*continued from page 20*)

cases they report "good" results with twenty-six, "equivocal" with four and "poor" with two. Authors of the paper are Drs. R. Gordon Douglas, Thomas L. Ball and Iona F. Davis of the Department of Obstetrics and Gynecology of the New York Hospital and Cornell Medical College.

DURING the past year Alton Ochsner, M.D., Chief Surgeon, Tulane University, and Mr. L. R. Snowden, Surgical Instrument Consultant, have developed and perfected a definitely improved instrument for holding surgical needles. This needle holder has been named the "Ochsner Diamond Jaw" needle holder in honor of the professional assistance and contributions made by Dr. Ochsner. Surgeons are frequently confronted with the aggravation of a needle turning while doing surgery. The secret of this improved instrument is to build into the inner jaws of a conventional needle holder an inlaid strip of diamond cut fine tooth, a very hard and tough material which offers terrific resistance to wear. These inner jaws are fitted with such precision that even the finest needle is held definitely secure each time it is grasped and suture can be handled with confidence and without slippage. This needle holder is being manufactured and nationally distributed under the trade name "Ochsner Diamond Jaw" by the Snowden Instrument Company, exclusively, at Los Gatos, California.

THE Navy has stopped accepting applications for commissions in the Medical Corps of the Naval Reserve from physicians in "Priority Two" as specified in Public Law 779—81st Congress, it was announced. Applications for Medical Corps Reserve commissions from physicians in "Priority One" have been closed since early last November. Applications already received by Offices of Naval Procurement from "Priority Two" physicians will continue to be processed, however, the Navy said. Medical students in the Navy's Ensign Probationary programs are not affected. The Navy announced also that it would continue to accept applications for the Medical Corps Reserve from physicians in Priorities Three and Four. "Priority Two" includes physicians and dentists who participated in the Navy's V-12 program or similar programs and those persons who were deferred from service in World War II for the purpose of continuing their education, who have had ninety days or more but less than twenty-one months of active duty subsequent to their completion of or release from the program or course of instruction.

REAR Admiral Lamont Pugh, MC, USN, was sworn in as twenty-fifth chief of the Navy's Bureau of Medicine and Surgery at a ceremony in the office of Secretary of the Navy, Francis P. Matthews.

AN improved Polyethylene Rod Vein Stripper is announced by Clay-Adams Co., Inc., New York, N. Y. Used in surgical treatment of varicose veins, this Cole stripper is 36 inches long and ⅛ inch in diameter. Made of flexible Polyethylene Rod, it easily follows the course of a vein, is readily manipulated, minimizes trauma during removal and lowers danger of vein perforation. Cole Vein Strippers may be ordered from local surgical supply dealers.

A NEW fireproof and explosion proof suction, pressure and anesthesia apparatus designed specifically for use when highly volatile anesthetic agents are used, and which provides for the dissipation of static electricity, is announced by J. Sklar Manufacturing Company, Long Island City, N. Y. Known as the No. 4138-C Tompkins Portable Rotary Compressor, it is described as the first pump unit that can be operated with safety in Class I, Group C locations, as defined by the Underwriters' Laboratories. These hazardous locations are atmospheres containing ethyl-ether, cyclopropane and ethylene.

VOLUNTARY hospital and medical care plans were upheld as a bulwark for "preserving our American way of life" by Dr. Theodore G. Klumpp, president of Winthrop-Stearns, Inc., pharmaceutical manufacturers, New York, addressing a national meeting of the Blue Cross and Blue Shield Commissions. Dr. Klumpp pointed out that Lenin, as the chief

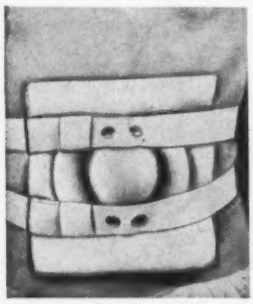
(*continued on page 30*)

The Surgeon's Mart

When you are in need of surgical instruments or medical supplies you will find the dealers and manufacturers listed below ready to serve you. For your guidance when purchasing supplies we submit this list.

COLOSTOMY & ILEOSTOMY APPLIANCES
Recommended by Distinguished Surgeons
Used in Leading Hospitals
IRRIGATORS, POUCHES, CUPS, BOWLS,
of different sizes & materials
Rubber—Plastic—Metal
Stock Models for immediate shipment
Disposable Liners
SPECIAL BAGS made to order in one week, with any size of opening desired. Real COMFORT, CONVENIENCE and DURABILITY may be had with appliances purchased from
R. GRICKS
202-11 Jamaica Avenue, Hollis 7, New York
'Phone: HOLLis 5-9077

THE TRASK COLOSTOMY DOME, the appliance that uses the 33 ply cellucotton disposable receiving pad. A new fresh pad after each movement keeps the patient immaculate at all times.



NOTHING TO WASH
Sold at all leading surgical supply houses..... $10.50
If your dealer cannot supply your patients, order direct but be sure to mention your dealer's name.
THE TRASK LABORATORIES
BOX 52. Newtonville, Mass.

YOUNG'S DILATORS
Extremely useful in the treatment and prevention of contracted anus (particularly following hemorrhoidectomy), as an aid in perineal dissection and repair following delivery.
Sold only on prescription—at your surgical dealer or ethical pharmacy
Adult Set sizes 1, 1½, 2, 3—for stretching anal sphincter.
Children's Set sizes 0, 1, 1½, 2—for preventing contracted anus.
Size 3 and 4 drilled to take towel clamps—for use in perineal repair.
Write for Literature and Reprints
F. E. YOUNG & CO. 460 East 75th Street Chicago 19, Illinois

FRACTURE EQUIPMENT
Ask your Dealer to show you RAJOWALT fracture equipment catalog
It will save you money
IMMEDIATE DELIVERY
Sold only through Surgical Dealers
RAJOWALT COMPANY
WARSAW, INDIANA

"Pressoplast"

Natural or Flesh Colored
Adhesive Cotton E-L-A-S-T-I-C Bandage
"Contura"—BANDAGE
skin protecting medicated
Write for Literature and Reprints
MFRS. OF ELASTIC BANDAGES AND DRESSINGS
Medical Fabrics Co., Inc.
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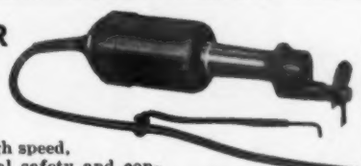
FOR YOUR PROTECTION
TRADE MARK OF QUALITY
SOLE MANUFACTURER OF
COLLISON SURGICAL PRODUCTS

SURGICALLY KLEAN
3616 FALLS ROAD BALTIMORE 11, MARYLAND TELEPHONE HOpkins 4575
The Surgical Engineering Company, Inc.

SPONGE BIOPSY FOR CANCER DIAGNOSIS
(Method of Dr. S. A. Gladstone)
Sponge Biopsy is simple, rapid, painless, reliable. Sponge Biopsy facilitates diagnosis in the early curable stage of cancer of the cervix uteri,* rectum, oral cavity, skin, etc. Sponge Biopsy has received awards at the Scientific Exhibits of the N. Y. State Medical Society and the American Medical Association.
For best results use Onkosponge No. 1 and Gladstone Sponge Biopsy Forceps, prepared and designed especially for Sponge Biopsy.
Write for descriptive leaflet and reprints.
* Ref. Am. J. Surg., March, 1951.
HISTOMED, INC.
181 Lafayette Street Paterson 1, New Jersey

STRYKER BONE SAW



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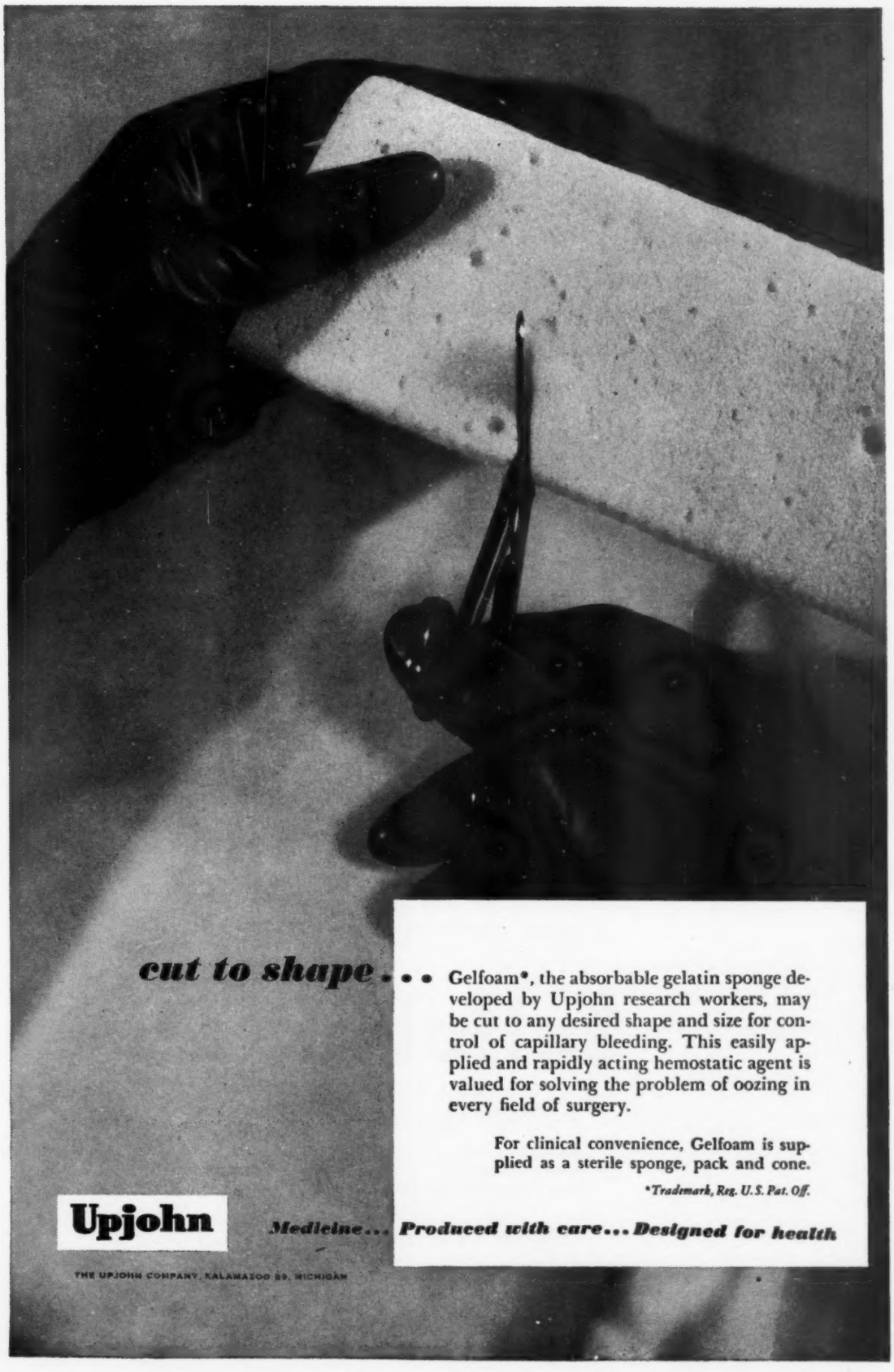

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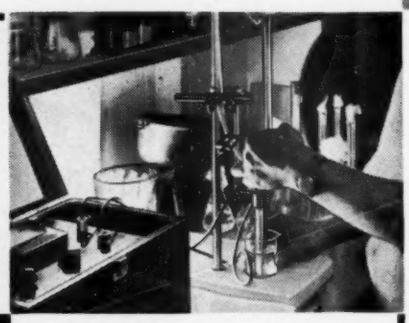

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1. Bigger, J.W.: Lancet 2:45, 1950.
2. Vollmer, H., Pomerance, H.H., and Brandt, I.K.: New York State J. Med. 50:2293, 1950.

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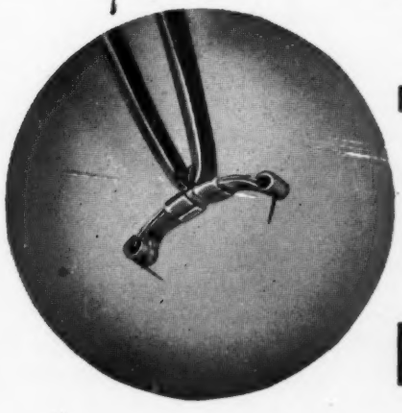

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Outside the Ivory Tower

(*continued from page 22*)

architect of Communism, assigned a position of importance to socialized medicine in the communistic scheme of things. Conversely, he said, free medicine, complemented by such health plans as Blue Cross and Blue Shield, with the goal of "better medical care for more people," is "one of the very important influences in preserving liberty, freedom, individualism, free enterprise, capitalism, the incentive state and the American way of life, all synonyms for each other."

HEART disease research will receive grants totalling more than $725,000 this year from the life insurance companies of the United States and Canada, it was announced by M. Albert Linton, President of the Life Insurance Medical Research Fund. The 1951 awards bring to nearly four million dollars the amount of money given to heart disease research by the life insurance companies since the Fund was organized in 1945.

DR. John F. Fulton, Yale physiologist, author and historian, has just been named to fill the newly created position of Sterling Professor of the History of Medicine. Dr. Fulton's appointment was announced by President A. Whitney Griswold, who said that it is "most gratifying that at such a critical time in world affairs the University has been able to emphasize this important influence of the humanities on medicine.

"This new chair," he continued, "is intended to make an important contribution to undergraduate premedical students as well as those pursuing the M.D. degree. It is particularly necessary now when it seems apparent that interest in the humanities may be weakened in the future.

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THE Hypospray method rather than needle injection has proved highly successful in anorectal analgesia. It eliminates the pooling of the oil in the tissue which may occur with the old needle method. Drs. Sidney Krohn, John B. Spriggs and C. Harwell Dobbs of the U. S. Marine Hospital, Baltimore, Md., point this out in an article scheduled for an early issue of The American Journal of Surgery.

AMERICAN boys entering employment at age eighteen have sixty-six chances in 100 of living to the retirement age of sixty-five. For their grandfathers who started work around the turn of the century the chances of attaining age sixty-five were only fifty-one in 100.

ONCE again we should like to mention a few worth while new books. If one desires a good work on any of the topics covered, we believe these books will prove of value.

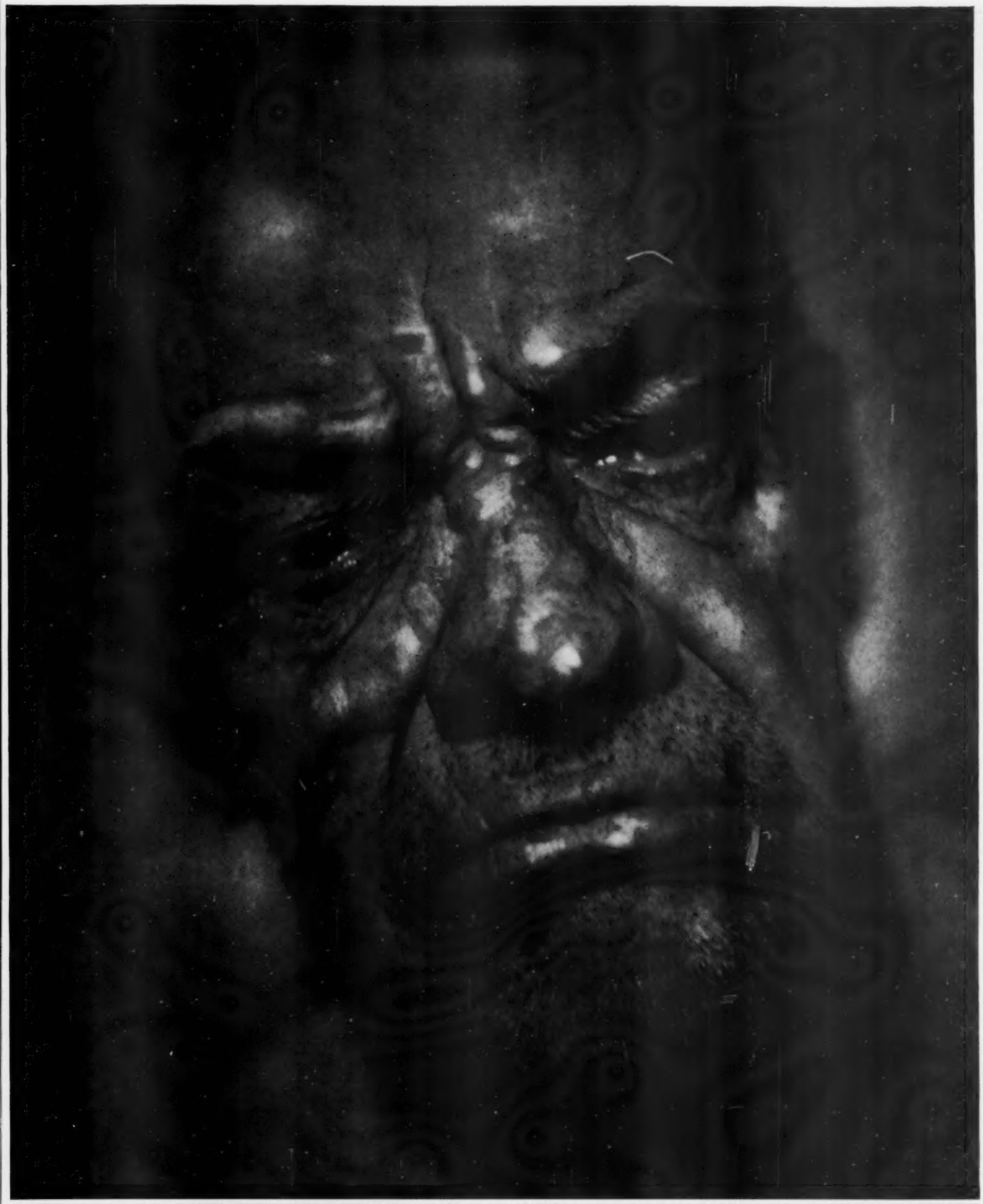
"Psychosurgery in the Treatment of Mental Disorders and Intractable Pain," by Walter Freeman, M.D. and James W. Watts, M.D., is a second edition which has been completely rewritten and reset. The conclusions discussed have been drawn from over 1,000 cases. It contains 638 pages, with 187 illustrations. It has a bibliography and is indexed. Charles C Thomas puts out this book for the price of $10.50.

"Atlas of Histologic Diagnosis in Surgical Pathology," by Karl T. Neubuerger, M.D., with a Section on Exfoliative Cytology, by Walter T. Wikle and photography by Glenn E. Mills, M.A., holds 460 pages, 880 figures and is indexed. The Williams & Wilkins Co. publish this excellent work. The price is $11.00.

"Anatomy of the Nervous System," by Olof Larsell, M.A., PH.D., has an introduction by A. T. Rasmussen, PH.D., and is a second edition. It boasts 520 pages, 374 figures, has references at chapter endings, and is indexed. It is a Grade A-1 book put out by Appleton-Century-Crofts, Inc.

"Indications for and Results of Splenectomy" was written by Drs. Frederick A. Coller, Alexander Blain, III, and Gould Andrews from the Departments of Surgery and Medicine, University of Michigan Medical School. It is from the American Lecture Series, has 100 pages, is illustrated and contains a bibliography. The price is $2.25 and Charles C Thomas is the publisher.

"Rest and Pain," a sixth edition, was written by John Hilton and is newly edited by E. W. Walls, M.D. and Elliot E. Philipp, M.A., in collaboration with H. J. B. Atkins, D.M., M.Ch. It is illustrated and holds over 500 pages. The J. B. Lippincott Co. publishes this book and the price is $10.00.



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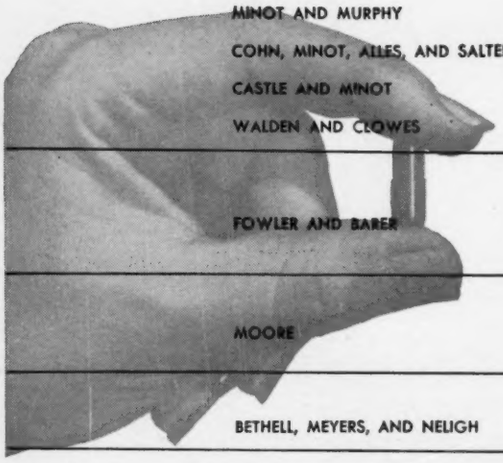

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A PRACTICAL JOURNAL BUILT ON MERIT

Sixtieth Year of Publication

VOL. LXXXI MAY, 1951 NUMBER FIVE

Editorial

CHOLECYSTECTOMY—POSITION OF SURGEON TO LEFT OF PATIENT FACILITATES TECHNIC*

THE purpose of this paper is to emphasize a few relatively minor alterations in the technic of gallbladder and biliary surgery which appear definitely to facilitate operative procedures in this region. One may often be rather reluctant to accept changes in any technic that is apparently satisfactory, relatively easy and in common usage. Convenience, habit and training are but a few of the factors which probably play some part.

Today there are two popular methods of teaching surgery. In one there is a very long period of assisting at operations until such a time that the apprentice becomes sufficiently qualified to do his own operating. In the other method the period of assisting is less prolonged and actual operating is begun somewhat earlier under direct supervision of an older surgeon who assists at the operation.

An individual who has undergone the type of training entailing a long period of assistantship is frequently struck by the fact that as an assistant structures may have been visualized better than after becoming the operator. When that individual has become more proficient in surgery and lends to the training of younger men who are being brought up in the second method, namely, that of being permitted to do their surgery a little earlier under direct supervision, he then may realize it is only the assistant's position which actually offers better view in some instances. This is particularly true in surgery of the gallbladder and portal triad.

It has been the inclination of many men doing pelvic-abdominal surgery to perform their operations while standing on the left side of the patient. A study has been made in which twenty-five such surgeons were directly questioned as to why they operated from the left side. The answer was universally that it was technically easier and allowed manipulation of clamps, sutures and cutting instruments with the right hand.

Questionnaires were sent to surgeons all over the country asking, "On which side of the patient do you stand when performing biliary tract surgery?" Three per cent of the replies were discarded because the surgeons were left-handed. The remaining 97 per cent answered in all instances that they worked from the patient's right side. These answers may not be a true evaluation because other surgeons were interrogated directly, and even though it was their common practice to operate from the right side, some stated that they occasionally would move over to the other side when dealing with a very difficult problem.

After completion of the aforementioned studies it was learned that Dr. Samuel Harvey[1] had for a long time been an advocate of per-

[1] HARVEY, SAMUEL C. Personal communication.

* From The Department of Surgery, The George Washington University School of Medicine, Washington, D. C.

forming gallbladder surgery from the left side of the patient.

Various other people such as anesthetists and operating room nurses were then interrogated in order to learn if they knew of anyone or had seen anyone doing gallbladder surgery who did not work from the right side of the patient. The answer in all cases was "No." In other words it appeared that most men doing surgery in the right upper quadrant of the abdomen operate solely from the right side of the patient.

Recently a study was made in an attempt to evaluate the advantages or disadvantages of shifting from one side of the patient to the other side when performing gallbladder surgery. Certain changes were carried out which were believed to facilitate the operation greatly and minimize difficulties.

A technic was established which has been carried out in fifty consecutive cholecystectomies as follows: After the patient has been anesthetized and the abdomen cleaned and draped, the operator and second assistant take places on the patient's right side with the first assistant and surgical nurse on the left. An upper right abdominal incision is made and the abdomen opened. Exploration of the abdomen is performed immediately to ascertain if there is any disease other than that in the right upper quadrant. Following exploration the operator and first assistant exchange places, allowing the former the entire left side of the patient to stand on without being crowded. It has so often been mentioned that the left hand of the first assistant retracting the structures medially allows great exposure of the biliary tree. To some extent this is true, but usually it has allowed the first assistant a better vision of the area than it has the operator. However, with the operator on the left side he is able to insert the middle finger of his left hand into the foramen of Winslow and by medial traction to put the portal triad structures under tension. The bowel, covered by a gauze pack, rests against the back of this left hand which is at all times under no stress or strain and is in a natural position.

Having elected to do a cholecystectomy the operator instructs the second assistant to lift the round ligament away from the operative field with a small retractor in his left hand, and with the right hand to put some traction on a clamp secured to the fundus of the gallbladder. The operator, with the hepatic artery, portal vein and common duct under perfect control between the thumb and first two fingers of the left hand, may then begin the dissection of the cystic vessels and duct. From a position on the left side of the patient there is no need for hyperflexion of the operator's left wrist or other strained attitudes. Dissection of the biliary structures is simplified in that the motion is similar to that used when inserting a suture. From the right side of the patient the operator must use a pulling action.

The first assistant has both hands free. He can maintain a bloodless field by using suction and is able to insert a retractor wherever necessary.

After the cystic vessels and duct have been exposed, clamped and cut, ligatures are applied. This is much easier while working on the left side of the patient. Both placement and tying of the ligatures are facilitated by the surgeon's left hand which is still deep in the wound.

Once the gallbladder has been deprived of its blood supply and the duct has been cut, it can be removed from apex to fundus much easier with the operator standing on the left side of the patient.

After the gallbladder is removed, the surgeon and the first assistant may then exchange places prior to covering the liver bed with peritoneum. When the surgeon moves back to the right side of the patient, he may close the peritoneal margin of the liver bed by first suturing the deepest edges together; the first assistant then uses one end of the suture for traction to facilitate closure of the denuded area. Finally the tied ends of the suture at the edge of the liver are used to pull the liver up and revisualize the structures before closing the abdomen.

This left side procedure has been mentioned just for cholecystectomy; however, there are other advantages. In exploration of the common duct or insertion of a T tube there are occasionally small veins located on the anterior surface of the common duct which when touched may cause troublesome oozing. When the operator is standing on the left side of the table with his fingers in the foramen of Winslow, the thumb can be used to occlude these veins completely, and an incision in the common duct may be quite bloodless. The insertion of a T tube, the arms of which are guided by the left hand, becomes much easier.

In management of the common duct when

performing pancreaticoduodenectomy for lesions of carcinoma of the ampulla or head of the pancreas the operator situated on the left side of the patient facilitates severance of the common duct and exposure of the portal vein. The latter is a factor which is quite important in order to avoid irreparable damage to this vein in the course of freeing away the duct, duodenum and pancreas.

In conclusion, it is believed that possibly because of long usage and habit surgeons universally stand on the right side of the patient when performing right upper quadrant surgery. Questionnaires and interrogation indicate that few surgeons make changes from side to side performing gallbladder surgery. During fifty cholecystectomies the technic was carried out in which the operator changed from one side to the other. It was concluded that this one procedure added a great deal of ease to the operation. This may not work well in the hands of all surgeons, but it is believed that there is sufficient benefit obtained by changing sides during biliary tract operations to warrant if not adoption at least a trial before any critical appraisal is forthcoming.

WALTER H. GERWIG, JR. M.D.

Original Articles

KRUKENBERG TUMORS OF THE OVARY

JAMES J. BERENS, M.D.
Cincinnati, Ohio

ONE of the more interesting but less common varieties of ovarian neoplasms is the Krukenberg tumor. Five cases of Krukenberg tumors of the ovary from the Cincinnati General Hospital during the years 1938 to 1948 are presented. The first case is believed to be the youngest patient reported with a Krukenberg tumor.

This ovarian tumor was described in classical fashion by Krukenberg[22] in 1896. He reported his findings on five cases; four of which he designated "fibrosarcoma mucocellulare (carcinomatodes)"; the fifth he called an endothelioma although it had numerous resemblances to the others. In the half-century interim since the publication of Krukenberg's treatise on the tumor now identified by his name, a sufficient number of authenticated reports on this particular neoplasm have been published to remove it from the rare category. One hundred sixty-five cases have been described in forty-six years and about half of these have occurred in a recent thirteen-year period. This reported incidence shows a definite and progressive increase. The increase is probably due to a combination of factors. More autopsies, more thorough surgical-pathologic investigations, a general increase in the number of publications and perhaps an increased incidence of gastric carcinomas, which are the most common source of these secondary ovarian tumors, contribute to the greater number of reported cases.

The age incidence of these lesions covers a wide range. The various series include patients as young as thirteen years (Case 1) through adult life to the age of sixty-nine years.[24] One would expect the highest incidence of these tumors to parallel that of gastric carcinoma which is the most common primary focus. In reports on various series of collected cases, however, it is found that all writers are not in agreement. J. Jarcho,[19] for example, states that only seven (or 20 per cent) of thirty-five cases occurred in patients over forty years of age. Simecek[39] noted the greatest frequency to be about the age of thirty-five years; Major[25] found the average to be thirty-six years. These reports would indicate that the greatest incidence of Krukenberg tumors occurs at an age corresponding to that of the active reproductive period or earlier in life than the average age incidence of gastric carcinoma. Leffel, Masson, and Dockerty,[23] however, noted that in a collection of forty-four cases the average age was 48.2 years.

PATHOLOGY

Krukenberg, in the description of his own five cases, described the pathologic features with marked clarity. He observed that the ovarian tumors were solid although his first reported case presented a large cyst with a carcinomatous wall in the left ovary and a solid tumor on the right. The tumors are usually bilateral and are frequently accompanied by ascites. Characteristically the entire ovary is increased in size and the general outline and shape of the normal ovary are maintained. The surface is smooth but may be lobulated, and rarely are there any adhesions between the tumor and surrounding structures. On section the tumor is solid with softer myxomatous areas dispersed throughout the structure.

On microscopic examination the most characteristic finding is the presence of large rounded or polyhedral cells. These cells are diffusely scattered or are arranged in rows or clusters. In the myxomatous areas they may present an alveolar arrangement. The cytologic appearance varies from large rounded cells with a slightly swollen body and a prominent-staining nucleus to those cells which appear

to be markedly swollen due to mucoid degeneration and in which the nucleus is pushed eccentrically to the cell periphery to give a signet-ring appearance. (Fig. 4.) The stroma shows a hyperplastic development of spindle cells. (Fig. 2.) Krukenberg remarked about the epithelial character of the tumor cells but could find no direct connection between them and the normal epithelial cells in the ovary. He considered the various forms of these cells to be different stages of mucoid degeneration of the stroma cells. Thus he designated the tumor as a "fibrosarcoma ovarii mucocellulare (carcinomatodes)." Krukenberg originally thought the tumors to be primary ovarian neoplasms. In studying these tumors histologically Leffel concluded that the most constant histologic finding is mucus in the epithelial cells.

Several years later it was shown by Schlagenhaufer[35] and others that the characteristic cells in the Krukenberg tumor were of true epithelial origin and not derived from the connective tissue stroma of the ovary. J. Jarcho recently stated that "pathologists who have studied tumors of the Krukenberg type are now convinced that there is no evidence that the stromal reaction is neoplastic or sarcomatous or that the large epithelial cells are derived from the stroma." It has also been shown by numerous investigators that the ovarian tumors are usually secondary neoplasms with the primary growth most frequently in the stomach and sometimes in the intestinal tract, gallbladder or breast. In many instances it is very difficult to identify clinically a primary focus because it may be latent. Even on pathologic examination the primary growth may be quite small and obscure.

ROUTE OF METASTASES

One of the most interesting and disputed points concerning this atypical ovarian tumor is the mode of spread from the primary focus to the ovaries. The study of the route of metastasis is not as simple as is the case with many secondary neoplasms. Evidence does not seem conclusive with regard to any particular route although various investigators formulate hypotheses on the basis of unusual findings. One of the unique features of this growth is the paucity of other lesions in the abdomen along the path between the primary lesion and the ovaries.

Regarding the method of spread, four routes are commonly listed to explain the metastases in Krukenberg tumors of the ovary: (1) lymphatic route; (2) peritoneal sedimentation with implantation of cells on the ovaries; (3) hematogenous spread and (4) direct extension to the ovaries. Most investigators support the first or second of these theories.

Those who believe that metastasis from the primary focus to the ovaries occurs via the lymphatic route include Novak and Gray,[29] Runyeon,[32] Amann[1] Shaw,[36] Fallas,[15] Meigs,[27] Simecek, Copland and Colvin[10] and Armstrong and Wolf.[4] Since carcinomas in general usually spread via the lymphatic stream, it is important to consider this method. Amann suggested that the retrogastric and other retroperitoneal nodes are invaded by cancer cells which produce a block in the lymphatic system. From here the cancer cells pass into the retroperitoneal lymphatics along either side of the aorta to the lumbar nodes and by retrograde migration through the lymph vessels to the ovaries. As evidence for this method Stone has reported malignant cells in the retroperitoneal lymphatics. The fact that with Krukenberg tumors the shape of the normal ovary is maintained favors this interpretation in which the invasion would be from the center of the gland. The smooth surface can be explained by the entrance of the cells from the hilum instead of from the outer tunic. Early tumor nodules have been found in the medulla with none in the cortex.[37]

The second theory for the spread of the Krukenberg tumor concerns the sedimentation of tumor cells originating in the primary growth through the peritoneal cavity to the pelvis where they invade the ovary. Among the advocates of this theory are Kraus,[21] Boyd,[6] Stone,[40] Schlagenhaufer,[35] Masson,[26] Cutler and Buschke,[12] Saccone and Gordon[33] and Hundley.[21] The richly vascular covering of the ovaries was judged by some to be fertile soil for the invasion of tumor cells especially since it is periodically traumatized by the rupture of Graafian follicles. The location of the ovaries in the lower part of the abdominal cavity would favor their selection as a seed place for germination of falling tumor cells. Stone comments that peritoneal implantation is undoubtedly a more common method of extension than has been previously supposed, and second to the liver, the ovaries

are a more common site for implantation than any other of the intraperitoneal organs.

The finding that the ovarian cortex is rarely involved early in the course of the disease (Leffel, one in forty-four cases) may be taken as evidence against this theory of metastasis. The fact that some of the primary gastric cancers are deep in the stomach wall and are accompanied by Krukenberg ovarian tumors is evidence against the theory that the cells are set free or broken off from the surface of the primary focus. Simecek's report that some of the primary tumors involve only the mucosa and submucosa of the stomach without involving the serosa substantiates this finding.

There is little evidence to show that the hematogenous route of spread of cancer cells to the ovaries to form Krukenberg tumors is common. Major reports a case of Krukenberg tumor of the ovaries secondary to gastric carcinoma in which typical signet-ring cells were found on microscopic examination in the blood vessels of the lungs. This route may be considered as a possibility, but the early lesions in the ovaries without a more generalized carcinomatosis is evidence that a more selective method is active.

Direct extension is another possibility of malignant spread. In primary tumors of the lower abdominal cavity this method is possible, but most of the parent tumors which yield Krukenberg tumors of the ovaries are in the upper abdomen.

CASE REPORTS

The following series of five cases was collected from the files of the Cincinnati General Hospital:

Case 1. No. 213788. R. C., a thirteen year old Negro girl was admitted May 12, 1946. She gave a history of apparently normal health until about one month prior to admission when gradually increasing lower abdominal cramping pain and constipation were noted. These symptoms were accompanied by progressive anorexia, weakness, fatigue and loss of weight. For three days before hospitalization the patient noted red streaked, watery stools once or twice a day and severe cramping peri-umbilical pains. At the time of onset of the pains the patient discovered a small mass in the skin of the left lower abdominal quadrant. Past history was essentially negative. No menarche had occurred but the patient had had axillary and pubic hair for about a year and her breasts were beginning to enlarge.

On admission examination the patient appeared to be acutely and chronically ill. The abdomen was moderately distended and tympanitic. A visible and palpable firm subcutaneous mass, 1.5 cm. in diameter, was fixed to the subcutaneous tissue in the left lower quadrant. Deep palpation in the left lower quadrant disclosed a firm, irregular tender mass. A peritoneal fluid wave was present. Pelvic examination was unsuccessful because of tenderness; the hymen was intact. On rectal examination a large, firm, nodular mass was palpable.

A barium enema demonstrated partial obstruction of the mid-portion of the descending colon. The subcutaneous nodule in the left lower quadrant was removed for examination. Microscopically the mass showed diffusely infiltrating areas of round and ovoid tumor cells. The cytoplasm of the tumor cells contained large amounts of homogeneous mucoid material. Irregular, small, dark staining nuclei were eccentric and frequently gave the cells a signet-ring appearance. Some suggestion of glandular formation was apparent.

The patient received deep x-ray therapy, but the course was progressively downhill. Abdominal paracentesis on June 18, 1946, removed 5 L. of serosanguineous fluid. Her course was complicated by bilateral acute parotitis. The patient died July 19, 1946.

At autopsy a large stenosing colloid adenocarcinoma was found in the sigmoid colon. Metastases were present in the regional lymph nodes, retroperitoneal tissues, mesentery, uterus, appendix, liver, pancreas, diaphragm, lungs, calvarium and dura mater. The right ovary was markedly enlarged measuring 15 by 11.5 by 6 cm. and weighing 734 gm. No ovarian adhesions to surrounding structures were present. On sectioning the ovary consisted of soft white tissue with a capsule 1.5 mm. thick. Microscopically the pathologic changes were typical of Krukenberg tumor of the ovary. (Fig. 1.) The left ovary was slightly enlarged and on section revealed soft red and yellow tissue. No microscopic preparation of the left ovary was available.

Comment. This girl, age thirteen, is believed to be the youngest patient with Krukenberg

tumor of the ovary to be reported. It is interesting to note that although secondary sex characteristics had begun to develop, the patient had never menstruated. The malignant growth apparently developed in the premenarche period, a period characterized by pronounced endocrine activity. The course from onset of symptoms until death was only a little more than three months. The numerous and remote metastases found at autopsy suggest that some of the secondary growths (in liver, lung, diaphragm, calvarium and dura mater) can best be explained by a vascular spread. Lymphatic spread probably accounts for the involvement of the regional lymph nodes, mesentery and retroperitoneal tissues. The method of extension in the right ovary from the primary tumor in the sigmoid was not definitely explained at autopsy.

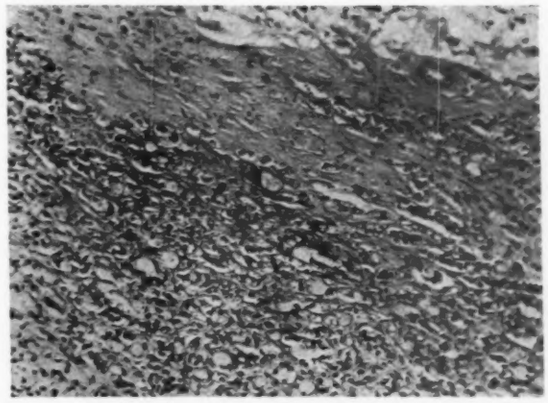

FIG. 1. Photomicrograph of Krukenberg tumor of the ovary taken from a thirteen year old girl; the parent tumor was a colloid carcinoma of the sigmoid colon. Rounded and polyhedral neoplastic cells contain dark-stained nuclei many of which are eccentrically located to give a signet-ring appearance.

Case 11. No. 43575. D. D., a forty-one-year old married white woman was hospitalized on four occasions. At the first admission (1932) hematemesis followed a six weeks' history of burning epigastric pains occurring two to three hours after meals. These pains were relieved by soda. The upper gastrointestinal series was interpreted as normal. She was placed on an ulcer regimen, and following the first hospitalization she had no symptoms of ulcer for three years except occasional epigastric burning. In 1935 she was admitted because of right upper quadrant pains radiating to the right scapular area for one year. Gallbladder and upper gastrointestinal series were reported to be negative. The patient was hospitalized in 1936 for complaints of dysmenorrhea, vaginal discharge, flooding and backache. Clinical diagnoses were rectocele, third degree uterine retroversion and cystic left ovary. Operation, March 16, 1936, included perineorrhaphy, supravaginal hysterectomy, left salpingo-oophorectomy and appendectomy. Numerous fine adhesions were reported about the right ovary. A left hydrosalpinx was found adherent to the cystic left ovary. No neoplastic tissue was found in the organs which were removed; her postoperative course was uneventful.

Sharp and boring epigastric pains recurred four months prior to her last hospital admission, April 1, 1938. The pains radiated to both subscapular regions and usually occurred about three hours after meals. They were relieved by soda. Three weeks prior to admission the patient had a massive hematemesis followed by fainting and tarry stools. On the day before admission she had tarry stools and again fainted. About a pint of clotted blood was vomited on the day of admission. On physical examination the temperature was 101.2°F., pulse 140, respiration 20 per minute, blood pressure was 105 mm. of mercury systolic and 45 mm. diastolic. The patient appeared acutely ill. Moderate tenderness was localized to the epigastrium; no masses were palpated. She was treated with blood transfusions and general ulcer regimen but continued to bleed. On the eighth hospital day gastroscopy failed to reveal ulceration or a bleeding point. Fluoroscopy with barium on the eleventh day was essentially negative. The gastric analysis revealed free acid 0, total acid 24 units.

Hematemesis continued on medical management. On the fourteenth hospital day she was explored surgically. A large deep ulcer surrounded by a wide indurated area was palpated high on the cardiac end of the stomach. The ulcer penetrated into the retroperitoneal space. A hard chain-like mass extended from the ulcer toward the spleen. Because of the poor condition of the patient and the position of the ulcer, no resection was done. The vessels surrounding the ulcer were ligated. Biopsy of a small gland on the lesser curvature of the stomach showed normal fat and lymph gland. Her postoperative course was uneventful and general improvement followed. On May 18, 1938, a stony hard mass was palpated in

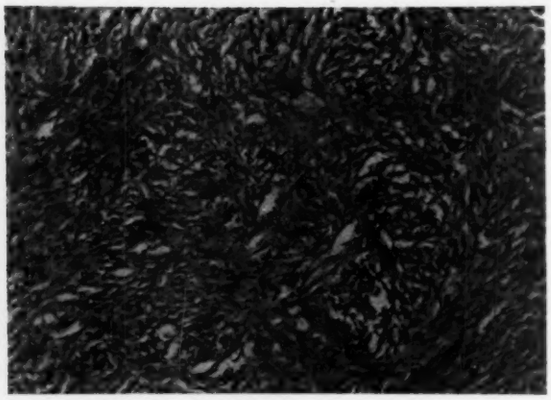

FIG. 2. Mucinous degeneration in metastatic carcinomas of the ovary (Krukenberg tumor); the tumor cells are diffusely scattered throughout the dense and hyperplastic stroma.

the posterior cul-de-sac extending into the region of the right ovary. The mass was fixed and non-tender. Gastroscopy was unsuccessful on May 26 and June 1, 1938. Because of the long ulcer history (six years) it was thought that the gastric ulcer might be a benign peptic ulcer and that the ovarian mass was a primary tumor. On June 6, 1938, a large, hard, well encapsulated right ovarian mass, which was adherent to the sigmoid and omentum, was removed. No evidence of peritoneal metastases was found at operation. The patient became jaundiced postoperatively and grew progressively worse due to a fulminating acute hepatitis. The liver never became enlarged clinically. She expired on June 15, 1938. Permission for autopsy was not granted.

Pathologic study of the right ovarian tumor revealed that the gross specimen consisted of an oval encapsulated mass about 12 cm. in longest diameter. On section the entire mass was quite homogeneous appearing cellular with a yellowish color. Microscopic sections demonstrated hyperplastic stroma with sheets of epithelial cells typical of Krukenberg tumor. (Fig. 2.)

Comment. The nature of the primary neoplasm in this patient was confused by the repeated negative x-ray studies, prompt improvement on peptic ulcer management and long duration. It seems likely that the gastric lesion was carcinoma rather than a benign ulcer. No obvious metastases were found at two laparotomies (April 15 and June 6, 1948.)

Case III. No. 164520. I. F., a sixty-four year old, white widow was admitted to the Gynecologic Service, June 8, 1943. History revealed progressive weakness and loss of 45 pounds during the preceding nine months; diarrhea with loose black stools for one month prior to admission; anorexia, nausea and recurrent, sharp, stabbing, poorly localized abdominal pains with chills and fever for one week. Past history included a supravaginal hysterectomy, right salpingo-oophorectomy and appendectomy in 1935 at another hospital. The pathologic report from that hospital showed a fungating adenocarcinoma of the body of the uterus, large simple ovarian cyst and chronic obliterative appendicitis. In 1942 following complaints of lower abdominal pains and masses, a laparotomy was done at another hospital. A large left ovarian cyst was so adherent to bowel and surrounding omentum that it was not removed. Two quarts of cloudy fluid were evacuated from the cyst; an omental biopsy showed no evidence of neoplasm. The patient stated that two large abdominal masses persisted in her abdomen after this operation until she began to have diarrhea one month prior to hospitalization at the Cincinnati General Hospital. She gave a history of four pregnancies with one miscarriage.

On admission the patient was a moderately obese female appearing chronically ill. A large, tender, mobile mass was palpated occupying the left lower quadrant and the medial aspect of the right lower quadrant. On vaginal examination the mass appeared to be adherent to the pelvic floor. An x-ray film of the abdomen was interpreted as showing a huge pelvic abscess containing gas. Barium enema demonstrated displacement of the sigmoid to the right by a gas-containing mass.

Exploratory laparotomy was performed June 29, 1943. A cystic pelvic mass containing fecal material was entered as adhesions between the ileum and mass were divided. Inside this mass an opening into the sigmoid 2 cm. in diameter was found. The cyst was drained, a rent in the ileum repaired and a cecostomy performed. A fecal fistula developed at the lower end of the wound. Postoperatively the patient became jaundiced and failed progressively. Exodus occurred on the twenty-fourth postoperative day.

At autopsy the diagnosis from gross examination was perforation of a diverticulum of the sigmoid. Microscopic studies, however, re-

vealed an anaplastic carcinoma of the sigmoid. Neoplastic cells infiltrated the muscularis and serosa; and chronic inflammatory changes were prominent in the involved area. Sections of the ovarian mass showed large dense areas of dark staining tumor cells and also small clusters of tumor cells scattered through the stroma of spindle-shaped cells. The findings were typical of Krukenberg tumor. (Fig. 3.) A soft tumor, 2 cm. in diameter, was found in the upper lobe of the right lung. Neoplastic cells in this tumor were anaplastic in appearance; but the type of tumor and primary site were undetermined.

Comment. The neoplasm in the sigmoid apparently perforated the cystic left ovarian tumor forming a fecal fistula between these adjacent organs. This presents the possibility that the Krukenberg tumor might have developed by direct extension although the morphology of the two tumors was quite dissimilar.

Case IV. No. 26387. O. S., a thirty-nine year old Negro married woman, was admitted to the outpatient department on November 17, 1944, with a history of right lower quadrant pain for three weeks. The pains were intermittent in character, radiated to the right upper quadrant and frequently terminated with vomiting. Vomiting had no relation to the time or type of meal. A rounded, slightly tender mass approximately 7 cm. in diameter was palpated in the region of the right ovary. The findings were interpreted as those of a tubo-ovarian abscess and the patient was treated for chronic pelvic inflammatory disease in the outpatient service. Her past history was negative except for high blood pressure since the age of eighteen; menarche occurred at the age of twelve; and menses were regular; gravida 1, pregnancy at the age of nineteen terminated in miscarriage.

On January 5, 1945, the patient was admitted to the hospital because the symptoms had persisted and intensified. Intermittent cramping right abdominal pains recurred every few minutes and vomiting became feculent on the day of admission; constipation increased. The patient had lost 40 pounds during the illness of nine weeks.

On examination the abdomen was distended and tympanitic. A visible and palpable mass about 7 cm. in diameter extended from the right costal margin to the right lower quadrant with each pain. Peristaltic rushes were present. A firm mass was felt in the right side of the pelvis on abdominal and pelvic examinations. Proctoscopy was negative; x-ray film of the abdomen showed many fluid levels in dilated loops of small bowel. The barium enema was interpreted as showing an obstruction at the hepatic flexure. The patient improved on conservative treatment with continuous Wangensteen suction, enemas and parenteral fluids. Pains and distention decreased, and the patient passed flatus and feces. On January 17, 1945, a right colectomy was performed to remove a constricting, annular lesion of the hepatic flexure. The tumor was adherent to the duodenum. Pathologic examination of the surgical specimen showed an annular carcinoma of the colon. Microscopically most of the tumor cells were anaplastic and in many areas they invaded the submucosa, muscularis and serosa. The cells were arranged somewhat in glandular formation. Postoperatively the course was uneventful.

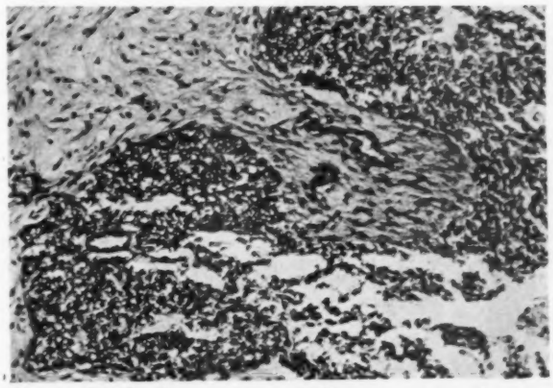

FIG. 3. Krukenberg tumor of the ovary secondary to an anaplastic carcinoma of the sigmoid showing areas of closely packed aggregations of tumor cells.

The patient remained asymptomatic except for intermenstrual bleeding until the morning of September 5, 1946, when she was awakened by sharp cramping epigastric pains which radiated to the left upper quadrant and were soon followed by vomiting. On admission the same day the abdomen was slightly distended and marked epigastric tenderness was present. Pelvic examination revealed hard induration in the posterior cul-de-sac and a mass about 18 by 12 cm. in the region of the left ovary. Improvement on conservative therapy was prompt and she was discharged eight days later.

The patient was readmitted December 13,

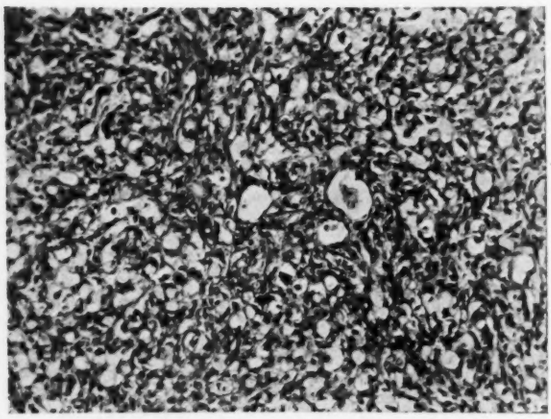

FIG. 4. Typical mucinous degeneration with prominent signet-ring formation in ovarian tumor which is probably secondary to gastric carcinoma.

1946, was a history of cramping epigastric pains, nausea, vomiting and no bowel movement for three days. The abdomen presented generalized distention and tenderness. A large irregular hard mass was palpated in the left lower quadrant. On December 15, 1946, an entero-enterostomy was performed to bypass an obstructing carcinoma of the small bowel. Two biopsies were taken from the large left ovarian mass.

Pathologically the ovarian fragments were grayish with a smooth surface. The sections consisted of closely packed neoplastic cells. Signet-ring cells and mitotic figures were abundant; the pathologic picture was typical of Krukenberg tumor.

Deep x-ray therapy was given in April, 1947, but her course was progressively downhill. She was admitted to the tumor service for terminal care on November 2, 1947, and died on January 12, 1948. Permission for autopsy was not granted.

Comment. The primary neoplasm in the hepatic flexure had undoubtedly spread by direct extension to the duodenum by the time of operation. At this operation and at the entero-enterostomy two years later no further tumor spread was noted except for the ovarian mass, a portion of which was removed and found to be a Krukenberg tumor.

Case v. No. 112693. M. R., a forty-eight year old single, white woman, was admitted January 31, 1939, with a history of progressive tiredness, weakness and 10 pounds loss of weight during the previous six months. For two months prior to admission she had had bouts of diarrhea and tenesmus. Menses had been less frequent and of shorter duration for the past six months. On admission the patient appeared to be chronically ill. No palpable abdominal masses were present. Pelvic examination revealed a small anteflexed uterus which was tender on manipulation; firm, tender, adnexal masses were palpated bilaterally. A barium enema was unsatisfactory because of discomfort and lack of cooperation. The large bowel showed generalized spasm; no organic lesions were demonstrated.

Operation was performed February 10, 1939. When the abdomen was opened, numerous peritoneal implants were encountered. Tumor masses of both ovaries were removed. Her postoperative course was uneventful. An upper gastrointestinal series, April 5, 1939, showed a constant filling defect just distal to the angularis of the stomach. The patient showed increasing anemia and weakness during the period of hospitalization. She was discharged April 12, 1939, and failed to return to the tumor clinic.

The specimen included the Fallopian tubes which were considerably enlarged and two well encapsulated ovarian tumor masses. The right ovary was oval and measured 5 cm. in its longest diameter; the left ovary was more spherical and measured 5 cm. in diameter. In cut section both tumors showed moderately firm cellular tissue with several small, serous-filled, cystic areas. Microscopic examination of both ovaries showed identical changes. The sections were made up almost entirely of tumor cells showing mucinous degeneration separated by small amounts of dense connective tissue. Occasional mitotic figures and numerous signet-ring cells were present. The findings were typical of Krukenberg tumor. (Fig. 4.)

Comment. The primary tumor in this patient was not located definitely but probably the gastric lesion demonstrated roentgenologically was the primary focus.

COMMENT

The average age of the patients with Krukenberg tumors of the ovary in this report was forty-one years. All of the ovarian tumors in these five patients were considered to be secondary to gastrointestinal neoplasms. The sites of the primary tumors were as follows: two patients had carcinoma in the sigmoid colon; one patient had carcinoma of the

hepatic flexure; and two had gastric ulcerations which were strongly suspected of being malignant tumors but were not examined microscopically. Of the three primary neoplasms examined pathologically, two presented a highly anaplastic picture (hepatic flexure of colon and sigmoid colon tumors) which was quite dissimilar to the ovarian growth.

SUMMARY

The present knowledge and literature on Krukenberg tumors of the ovary are reviewed. Five cases of Krukenberg tumor of the ovary are presented. The first case in this report, that of a girl age thirteen years, is thought to be the youngest patient to be described in the literature with this disease.

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NON-PUERPERAL INVERSION OF THE UTERUS*

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INVERSION of the uterus is not common in obstetric practice and is indeed a rarity for the gynecologist. The purpose of this paper is to emphasize the gynecologic as distinct from the obstetric knowledge of this condition by summarizing the literature and reporting a most extraordinary example of this condition. Inversion of the uterus may be classified in two groups: (1) puerperal or obstetric, (a) acute, (b) chronic; (2) non-puerperal or gynecologic, (a) tumor-produced, (b) idiopathic.

Puerperal inversion is associated with abortion, miscarriage or term delivery; non-puerperal inversion occurs in a non-pregnant uterus. In the puerperal variety acute inversion is considered to occur within thirty days of the termination of pregnancy, chronic after that. In the non-puerperal variety Busey[1] suggests the term, sudden and gradual for acute and chronic, whereas Winkel[2] considers all non-puerperal cases as chronic. Because the thirty-day limit serves no useful purpose in the non-puerperal variety of inversion, it may be better to emphasize etiology by classifying these cases into tumor-produced and idiopathic while realizing that either may sometimes present themselves as an acute emergency. Non-puerperal, tumor-produced inversion is associated with a neoplasm of the body of the uterus while the idiopathic variety has no recognizable cause.

This classification may be considered a modification from Mantel[3] who used obstetric and surgical types of inversion rather than puerperal and non-puerperal. However, he thought that surgical was always associated with tumors. Provision must be made in the classification for the idiopathic non-puerperal variety although there seems to be but a single case reported in the last thirty-eight years. The German literature has referred to onkogenetic inversion, but the term tumor-produced has been used instead. An exact translation of onkogenetic inversion would indicate a tumor produced by inversion whereas the reverse is intended.

The non-puerperal variety of inversion is least common and for the most part has received attention only incidental to the more common variety. Das[4] in 1940 was able to collect 391 cases of inversion of which about fifty-eight or 15 per cent were non-puerperal.

CASE REPORT

This patient, No. 426410, gave a history of having a normal menopause in 1913 at the age of fifty-three. Following this there was no further vaginal bleeding until December, 1946, after which there was continuous vaginal spotting. On June 23, 1947, the patient was admitted for dilation and curettage. She was then eighty-seven years old. Examination at that time showed a cervical os dilated by the protrusion of a necrotic polypoid mass. Examination of the uterus was unsatisfactory but it was thought to be at least two times its normal size but movable. Because of the patient's advanced age no anesthetic was used for the endometrial curettage. A pathologic examination revealed a low grade sarcoma probably of endometrial origin. Although a general medical evaluation showed the patient to be somewhat feeble, no serious abnormality was demonstrated. Nevertheless, a decision was made to use intrauterine radium as the only therapy. Accordingly on July 24, 1947, she received 3,375 mg. hours intrauterine radium by three 25 mg. tandem tubes.

Following this she was observed from time to time in the outpatient department. There were no symptoms but on several occasions it was noted that the uterus was about four times its normal size. On August 16, 1948, it was noted that the lower abdominal mass was much smaller and that there was a large papillary mass in the vagina. This was thought to be a papillary fibrosarcoma projecting through the cervix and she was admitted to the hospital for a vaginal removal of this tumor.

A general medical survey at that time showed arteriosclerotic heart disease with minimal cardiac failure. She was digitalized prior to the

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operation which took place on August 23, 1948. Under pentothal anesthesia® it was noted that a papillary necrotic tumor arose from the region of the cervix and filled the vagina. The cervix could not be identified. The fundus was noted to be about normal in size or somewhat below normal. As the pedicle of the tumor was large, it was grasped with a kidney pedicle clamp and severed. Examination of the specimen revealed that the amputation had removed the body of the uterus which was inverted. Tumor was still present in the stump of the uterus remaining high in the vagina. (Fig. 1.) As the patient was in good condition, an immediate total abdominal hysterectomy and bilateral salpingo-oophorectomy was undertaken. The technic of this operation varied in important details from a total hysterectomy in a non-inverted uterus and is illustrated and described. (Fig. 2.) All visible neoplastic tissue was removed.

Abdominal rather than vaginal hysterectomy was selected because a large amount of tumor remained in the vaginal vault and it was judged that the operative procedure in its presence would be technically difficult. Furthermore the large diameter of the cervix made it at once apparent that the ureters were in close proximity.

The patient was out of bed on the day of operation and had a remarkably smooth postoperative course. She was discharged on the eleventh postoperative day. Pathologic examination revealed sarcoma of the uterus with extension to the cervix. The tubes and ovaries showed no growth. When last heard from on May 1, 1950, she was enjoying her former fair state of health and had passed her ninetieth birthday.

Inversion has been described as complete or incomplete. According to Thorn[5] if any part of the fundus passes through the cervical os the inversion is called complete. He states that 75 per cent of tumor-produced inversions are complete.

In Das' collection 92 per cent were complete while all the more recent cases reported have been complete. The diagnosis of incomplete non-puerperal inversion is attended with obvious difficulties. For practical purposes all important cases of non-puerperal inversion may be considered as complete.

Inversion of the vagina and prolapse of the uterus have been reported associated with uterine inversion. The patient whose case was reported herein is an example of complete, tumor-produced, inversion of the uterus.

Etiology. Idiopathic non-puerperal inversion is, as the name implies, not associated with any demonstrable abnormality. Thorn[5]

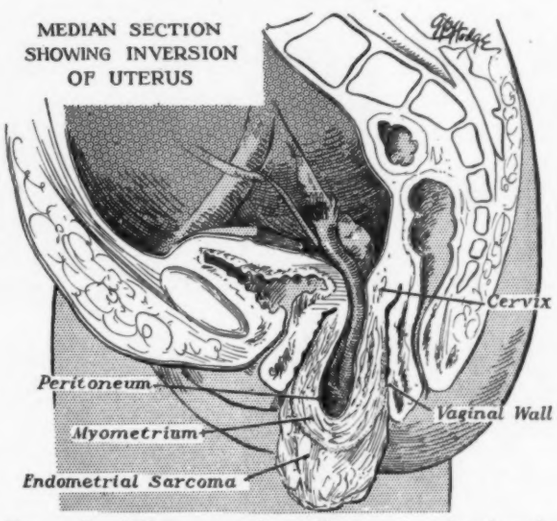

FIG. 1. Semi-diagrammatic median section showing the inversion of the uterus associated with endometrial sarcoma.

was able to collect thirteen cases and there has been apparently only one case[6] reported in the last thirty-eight years. Tumor-produced, non-puerperal inversion is most often associated with submucous uterine fibroids but has been reported with carcinoma of the body of the uterus and sarcoma of the uterus. Das in 1940 collected forty-seven cases due to fibroids, four due to sarcoma and three due to carcinoma, of which one was an adeno-acanthoma. Since his report an additional case has appeared due to fibroids[7] and one due to sarcoma.[8] The present case is therefore the sixth patient to be recorded with a sarcoma.

Symptoms and Diagnosis. In non-puerperal inversion the accident of inversion is usually difficult to recognize even in retrospect. The idiopathic variety in which the accident is often abrupt may be an exception and accompanied with pain and shock as in the case reported by Aronson and Karen.[6] For the most part the tumor-produced variety is associated with abnormal vaginal bleeding and a vaginal mass.

As would be expected the non-puerperal variety occurs most often in older women. This is in contrast to the puerperal variety in which according to Das over half the cases occur in

FIG. 2. Total hysterectomy and bilateral salpingo-oophorectomy for tumor produced non-puerperal (gynecologic) inversion of the uterus. Upper: the findings at operation; the round ligaments have been severed and the right infundibulopelvic ligament is being severed. Lower left: Because the bladder may be involved in the inversion, care must be exercised in denuding the bladder peritoneum; it should be severed as far within the inverted uterus as possible. Lower right: the inverted uterus presents a mass of much greater diameter than a normal cervix; for this reason the ureters are in close proximity. The T-shaped inversion in the pubocervical fascia, as recommended by Richardson, is particularly desirable as this allows the ureters to drop away from the immediate operative area; after the specimen has been removed the operation is completed as in usual total hysterectomy.

patients under the age of thirty. Of the women in Das' non-puerperal series 21 per cent were between thirty-one and forty, 29 per cent between forty-one and fifty and 25 per cent between fifty-one and sixty. The youngest patient was sixteen years old and the oldest seventy-nine years old. Our patient, therefore, exceeds by ten years the oldest previously reported case.

If the pelvic examination is carefully made and the findings properly interpreted, the diagnosis of inversion should be easily made. However, in most instances including our own the possibility is not entertained, and the diagnosis is made only at operation. In several reported instances and in the case reported the diagnosis was not recognized until the inverted body of the uterus was amputated and the peritoneal cavity thereby opened in an attempt to remove what was thought to be a submucous myoma or large endometrial polyp.

The history or record of an abdominal tumor which has diminished in size, the presence of a vaginal tumor, the absence of a cervical ring, inability to sound the uterine cavity and the cup-shaped or apparent absence of the uterine body should make the diagnosis very clear if the possibility is kept in mind.

A differential diagnosis will usually lie between a submucous vaginal myoma without

inversion and the same tumor with inversion. The diagnosis should be considered in cases of vaginal submucous myoma, especially in the older age group.

Treatment. Non-puerperal inversion of the uterus is too rare and experience with this condition has accumulated over too many years to render statistical tabulations of value in determining the best method of therapy.

Suffice it to say that vaginal hysterectomy, abdominal hysterectomy, vaginal excision of the tumor and reposition of the uterus both spontaneously and manually and combinations of these procedures have been used. The mortality has been surprisingly low. Das collected twenty-two cases of vaginal hysterectomy with two deaths, abdominal hysterectomy in two cases without mortality and vaginal excision of the tumor followed with spontaneous reduction in three cases without mortality.

It is clear that with non-puerperal inversion associated with submucous myomas hysterectomy may not be necessary if the peritoneal cavity is not opened. If the cavity is opened, either vaginal or abdominal hysterectomy becomes necessary. In inversion associated with malignant tumors a radical operation may be indicated.

The technic of total abdominal hysterectomy in uterine inversion varies from the usual hysterectomy in important aspects as indicated in the accompanying figure.

Most patients with idiopathic non-puerperal inversion have been treated with hysterectomy; but if such a diagnosis could be made with assurance, reposition might be possible.

SUMMARY

Non-puerperal inversion of the uterus occurs most frequently in the older age group in contrast to puerperal inversions. The tumor-produced variety has been reported associated with submucous fibroids, endometrial carcinoma or sarcoma of the uterus. The diagnosis should be clear although it is seldom made preoperatively. An extraordinary example of this condition associated with sarcoma of the uterus is presented with the technic of total abdominal hysterectomy used in the presence of inversion.

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MEASUREMENT OF BLOOD LOSS DURING SURGICAL OPERATIONS*

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THE maintenance of the fluid balance of surgical patients is one of the most important responsibilities of the modern surgical team, and the proper replacement of blood is perhaps one of the most important phases of this maintenance. This is true not only because it is an excellent prophylactic measure against shock but also because it aids in decreasing postoperative morbidity. In order to obtain optimal effects, however, the blood must be replaced at the proper time—as the patient loses it—and in the proper amount. Although most surgeons and anesthesiologists well appreciate this fact, they are often faced with the problem of accurately estimating blood loss in order to avoid under-replacement or over-replacement, both of which are extremely important in poor risk patients. Purely subjective estimation by the surgical team has been shown to be often grossly inaccurate and at times the errors of personal judgment may reach dangerous levels, particularly in the poor risk patient. In order to solve this problem several methods[1–5] have been proposed, but of these the direct measurement as the operation progresses is the only practical and reliable means of determining blood loss. It is the purpose of this article to present a simple and practical method which we have used to accomplish this in 748 operations and also to present a complete review of the American literature.

The measurement of blood loss during surgical operations has been reported by several authors and in some clinics it has become a routine procedure, particularly in poor risk patients. Gatch and Little[6] in 1924 were the first to report measurement during some of the more common operations in general surgery. They used the acid hematin method which involves washing all the sponges, linen and instruments free of blood and then adding hydrochloric acid to make the washing a 0.1 N solution prepared from the blood of the patient before surgery. They commented on the large loss of blood during certain operations, particularly radical mastectomy in which there seemingly was no excessive bleeding at any time during the procedure. Blain[7] in 1929 discussing his experience with 3,000 transfusions emphasized the fact that the amount of blood lost during operations is often several times greater than estimated by the surgeon. He urged the preoperative correction of anemia and the immediate replacement of blood loss during operation and condemned the procrastination of some surgeons and the delay in giving blood transfusions until after shock had developed. Coller and Maddock[8] in 1932 reported their observations in measuring fluid loss including blood during eighteen operations and concluded that the amount lost was greater than they had estimated. In 1937 Pilcher and Sheard[9] reported the average blood loss in two series of transurethral prostatic resections as compared to a group of forty-nine general surgical cases. The first series of fifty-five cases had a blood loss of 479 cc. and in the second series studied after alterations in their technic the blood loss was reduced to 291 cc. Hubly[10] in the same year, while investigating the hemostatic properties of congo red during this type of operation, determined the postoperative blood loss was at least two-thirds of that which occurred during operation.

White et al.[11] studied blood loss in thirty-seven neurosurgical operations and found that the loss during extensive intracranial procedures averaged from 500 to 1,200 cc. and even up to 2,000 cc., explaining such relatively large loss as due to extreme vascularity of the scalp and difficulty in controlling the bleeding in these cases. They also determined that the reduction of concentration of red blood cells, hemoglobin and hematocrit readings continues progressively and is found to be lowest during the fourth postoperative day. In 1938 Stewart

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and Rourke[3] studied hematocrit changes induced by blood loss and trauma and found that with the loss of blood there is usually a decrease in blood volume without physical or chemical changes of the blood, thus demonstrating the fallacy of assuming quantitive relationship between changes in the concentration of hemoglobin and plasma protein and changes in plasma volume. They were also the first to show that the decrease in total blood volume is greater than can be accounted for by a loss of blood at the site of the wound during the operation, indicating that there is an additional loss into the tissues. In 1939 Nadal[12] presented a series of sixteen orthopedic operations in which he investigated not only the blood loss but also the percentage of the volume of blood lost and its relationship to shock. He found that patients who lost between 15 and 20 per cent or over of the total blood volume frequently went into peripheral circulatory failure. Nesbitt and Conger[13] in 1941 measured blood loss during the operative and postoperative period of 100 transurethral prostatectomies and found that it averaged 169 cc. during operation and at least two-thirds of that amount during the postoperative period, confirming the work of Hubly.

In 1942 Wangensteen[14] described for the first time the simple gravimetric method of determining blood loss with which he determined that the average loss in gastric resections was from 300 to 500 cc. In the same year Buxton and White[15] measured blood loss in 109 patients undergoing surgery of the chest and determined that the loss was about 700 cc. for each stage thoracoplasty and about 1,600 cc. for both lobectomy and pneumonectomy. They strongly advocated large transfusions during these operations. Oppenheim[16] in 1944 measured the amount of blood loss in abdominal operations and concluded that although the loss was not excessive, a transfusion of 500 to 600 cc. during the operation is of great benefit to the patient operated upon for cancer of the gastrointestinal tract.

Coller and associates[4,5] wrote two articles in 1944 in which they reported the investigation of blood loss and the relationship between the amounts of blood lost and the changes in the hematocrit, hemoglobin and plasma protein concentrations before and after operations. They concluded from their findings that no correlation exists among the amounts of blood lost and changes in these values. Therefore, these determinations cannot be used to estimate the need for blood volume replacement. They contended that the patient benefits most when the blood loss is replaced by blood given as the loss occurs and believed that even minimal losses retard convalescence, that any loss over 300 cc. in healthy adults should be replaced and that all loss during operations in aged, undernourished, seriously ill or bedfast patients should be replaced with equal quantities of blood.

In 1946 Baronofsky[17] compared the colorimetric and gravimetric method in twenty-one patients and found that there was a close relationship between the two methods and, therefore, advocated the simpler gravimetric technic. Two years later Lenahan et al.[18] published their findings in 270 patients who had undergone various surgical procedures and concluded that the effect of blood loss depends upon a relationship of the amount lost to the total blood volume, the rapidity of the loss and the preoperative status of the patient. Lyon et al.[2] recently measured blood loss during various surgical procedures by the standard colorimetric and gravimetric methods and compared the results with those obtained with the red cell volume method. They found that the operative blood loss measured by the latter method was higher than that obtained by either colorimetric or gravimetric procedure. They explained this discrepancy by pointing out that in addition to the blood removed from the wound there is some loss in the surgical specimen, some infiltrated into the wound and surrounding tissue spaces and therefore not absorbed by sponges, and some immobilized in vessels proximal to the ligatures.

The present authors have compiled the findings of these different investigators in an effort to compute an "average blood loss" for different operations. These are shown in Table 1.

PRESENT INVESTIGATION

Method of Study. For most of this study we have used the gravimetric technic which is based on the use of sponges, packs, towels or other linen employed for collecting blood during the operation and weighing them after use. A weighing scale accurate to 0.1 gm. is used. Dry sponges and packs do not have to be weighed before each operation because they are remarkably uniform in weight and come

TABLE 1

BLOOD LOSS DURING SURGICAL OPERATIONS—REVIEW OF THE AMERICAN LITERATURE

Operations	No. of Cases	Blood Loss in cc.		
		Maximum	Minimum	Average
1. Neurosurgical				
Brain	19	2,150	574	1,287
Exploratory craniotomy	12	1,100	542	803
Spinal cord	12	1,264	255	655
Thoracolumbar sympathectomy	6	950	105	325
Lumbar sympathectomy	4	309	153	215
Others	7	950	86	65
2. Neck Surgery				
Thyroidectomies	43	888	16	249
Radical neck dissections	1	400	400	400
Others	1	174	174	174
3. Breast Surgery				
Simple mastectomies	3	220	190	205
Radical mastectomies	27	1,272	196	690
4. Thoracic Surgery				
Thoracoplasties	102	2,565	97	705
Thoracotomies (exploratory)	12	2,375	424	1,158
Lobectomies	24	3,050	475	1,558
Pneumonectomies	17	2,983	691	1,558
5. Gastric Surgery				
Gastric resection	99	1,432	150	441
Vagotomy	10	690	165	423
Others (enterostomies, etc.)	13	305	15	120
6. Biliary System Surgery				
Cholecystectomies	26	357	51	171
Bile ducts operations	20	1,455	75	460
7. Splenectomies	2	160	58	109
8. Intestinal Surgery				
Small intestine (resections and others)	11	1,425	50	704
Large intestine				
Abdominoperineal	32	2,420	183	619
Other resections	27	450	13	133
9. Appendectomies	110	62	4	10
10. Pelvic Surgery				
Hysterectomies	43	629	40	358
Others (salpingectomies, oophorectomies)	34	579	14	153
11. Miscellaneous Intra-abdominal	6	1,257	93	536
12. Herniorrhaphies				
Inguinal	40	263	6	58
Ventral	4	306	48	146
13. Urologic				
Nephrectomies	12	845	208	484
Transurethral prostatic resection	237	1,254	4	296
Suprapubic	10	1,235	265	551
14. Perineal	2	650	400	525
15. Hemorrhoidectomies	20	150	20	55
16. Orthopedic				
Major (bone grafts, amputations)	28	2,790	103	795
Minor	5	176	40	95
Total	1,081			

from the autoclave at a constant level of dryness. Immediately after use the sponges are weighed by the circulating nurse so that evaporation from them does not become an item of importance. In intra-abdominal and intrathoracic operations serous fluid is absorbed which is accounted for along with the blood. The complete gain in weight of sponges is treated as blood loss, each gram being considered as 1 cc. with no correction being attempted for the slight difference of the specific gravity of the blood from unity.

In the first 132 operations we used dry sponges as advocated by Wangensteen,[14] but many surgeons commented that it was a decided disadvantage not to use saline sponges in certain operations. We, therefore, undertook to modify the technic so that the wet sponges could be used whenever necessary. This is also a simple procedure and as accurate in the determination of blood loss as using dry sponges. The sponges are, of course, moistened with saline which is measured by a scrub nurse. Whenever saline is needed, the circulating nurse under aseptic conditions pours it into a sterile graduated 1,000 cc. cylinder and records the amount of saline on the especially prepared blood loss chart. The scrub nurse then transfers the measured amount of saline to the sponge basin. Whenever necessary she moistens the sponges in the saline and then squeezes as much of the excess saline as possible so that none is spilled out of the basin or while the sponge is being given to the surgeon. At any point during the operation that the blood loss is to be determined, the amount of saline used is calculated by measuring the amount remaining. The amount used is added to the weight of dry sponges employed and this is subtracted from the total weight of the used sponges. If suction is employed, the amount of blood in the suction bottle is included. The amount of blood lost on the drapes, surgeons' gowns and gloves is not usually measured because it is not practical to weigh these. However, measurement by the colorimetric method in several cases indicated that this often does not exceed 50 cc. The amount of blood spilled on the drapes is minimized by sewing towels to the skin immediately after the skin incision is made. The towels, of course, are weighed and the amount of blood on them is calculated.

With only a simple explanation of the procedure and some emphasis on the importance of certain details, we have trained our surgical nurses so well that the amount of saline that is spilled and thus unaccountable is minimal. This has been confirmed by many preliminary experiments with a measured amount of saline.

The colorimetric method was used for the determination of the blood loss in fourteen transurethral prostatic resections, and the red cell volume method was employed in two cases undergoing intracranial surgery.

Results. The amount of blood loss as determined by the aforementioned methods during 748 operations is shown in Table II. These operations were performed by fifty-six different surgeons who represent a cross section of surgical skill in two general hospitals. The cases have been grouped in fifteen main categories and the maximum, minimum and average blood loss has been shown. It is of interest to mention that our figures were consistent with those figures found in the American literature, as shown in Table I, in which the average values obtained by all the other investigators are presented with our averages. It is important to note that many operations entail a loss of more than 500 cc. of blood, particularly radical neck dissections, radical mastectomies, intrathoracic procedures, removal of brain tumors, perineal repairs and orthopedic operations. Many of the patients who undergo these operations are usually in the old age group or in poor condition or both and cannot tolerate the loss of even small amounts of blood and invariably develop shock if it is not promptly replaced.

The patient who lost 3,944 cc. during a nephrectomy presented a very severe problem because for several hours after one of the major anomalous vessels was inadvertently torn by the surgeon, the patient was in grave condition in spite of immediate replacement. We are convinced that under-replacement would have prevented recovery whereas over-replacement may have been just as deleterious to a heart which had been weakened by the episode.

COMMENTS

The importance of proper replacement of blood loss during and after operation has been recently re-emphasized by several clinical investigators[2] who have demonstrated that although there is a compensatory increase in plasma volume and circulating plasma proteins following uncompensated blood loss in the well hydrated patient, there is no such compensa-

TABLE II

BLOOD LOSS DURING SURGICAL OPERATIONS (AUTHOR'S SERIES)

Operation	No. of Cases	Maximum (cc.)	Minimum (cc.)	Average (cc.)	Literature Average Loss (cc.)
1. Neurosurgical Operations					
Brain operations	4	1,434	1,096	1,159	1,287
Craniotomy	6	905	521	741	803
Spinal column	15	1,004	402	674	532
Spinal cord	3	1,204	798	992	655
Thoracolumbar sympathectomy	11	1,083	285	655	325
Lumbar sympathectomy	10	850	165	314	215
Others	4	871	440	667	65
2. Neck					
Thyroidectomy	15	739	111	320	249
Radical neck dissection	8	1,154	528	759	400
Thyroglossal cyst	4	511	363	470	.....
Others	...	.....	.....	.....	174
3. Breast					
Simple mastectomy	11	394	62	151	205
Radical mastectomy	53	1,608	202	647	690
4. Thoracic Operations					
Exploratory thoracotomy	16	1,246	197	705	1,158
Lobectomy	11	1,905	1,056	1,482	1,558
Pneumonectomy	15	1,810	238	1,455	1,558
Transthoracic diaphragmatic hernia	4	1,688	870	1,148	.....
Thoracoplasties	...	.....	.....	.....	705
5. Biliary Operations					
Cholecystectomy	36	648	39	228	171
Bile ducts operation	9	801	102	416	460
6. Gastric Operations					
Subtotal gastric resection	30	1,650	131	576	441
Vagotomy	3	206	115	159	423
7. Splenectomy	4	797	97	376	109
8. Small Intestinal Operations					
Resections	27	829	108	511	704
Entero-enterostomy	18	252	75	183	.....
9. Large Intestinal Operations					
Abdominoperineal	12	1,132	432	790	619
Other resections	31	1,337	187	511	133
Others	6	570	86	206	.....
10. Appendectomies	36	349	19	76	10
11. Pelvic Operations					
Hysterectomies	61	1,798	69	444	358
Adnexa operations	19	1,054	51	281	153
12. Miscellaneous Intra-abdominal	...	.....	.....	.....	536
13. Herniorrhaphies					
Inguinal	48	861	9	35	58
Ventral	24	1,354	56	459	146
14. Urologic Operations					
Nephrectomies	21	3,944	64	708	484
Cystectomies	3	973	562	810	.....
Perineal prostatectomies	2	918	382	650	.....
Transurethral prostatic resections	21	1,006	130	365	296
Suprapubic	...	.....	.....	.....	551
Others	13	310	133	209	.....
15. Perineal Operations					
Vaginal repairs, hysterectomies, cystocele	54	831	114	483	525
16. Hemorrhoidectomies	...	.....	.....	.....	55
17. Orthopedic Operations					
Arthrodesis of shoulder	18	623	401	531	783
Open reduction upper extremities	6	589	321	466	1,153
Bone grafts upper extremities	8	1,232	607	799	570
Hip-nailing or arthroplasty	18	1,657	148	521	616
Open reduction lower extremities	12	923	275	496	630
Bone grafts lower extremities	15	1,784	565	1,076	2,070
Amputations	...	.....	.....	.....	357
Others	3	194	96	155	1,308
Total Cases	748				

tory increase in the red blood cells. In such cases in which blood loss is not replaced the depleted red cell volume does not return to normal until several weeks after the loss occurs. In other words the body is able to compensate for loss of plasma but its ability to restore depleted red cells is very limited. In addition, these investigators have shown by blood volume studies that there is not only loss of blood from the wound where it is apparent, but there is also a loss into the tissues, in the surgical specimen and in the vessels proximal to the ligatures (where it is immobilized and therefore lost to the circulating blood) which is not apparent. These studies have also revealed that there is usually a postoperative loss which may be significant and at times may be as large or larger in amount than the operative loss. Because such losses are usually insidious the clinical signs customarily observed following acute blood loss may be absent.

This decrease in oxygen-carrying red blood cells causes varying degrees of hypoxia which increase the postoperative morbidity, and if the patient's condition is such, may lead to severe disturbances of the cardiocirculatory mechanism and possibly end up in circulatory failure. It is mandatory, therefore, that the surgical team replace the blood loss during the operation as the patient loses it for it is much simpler to prevent shock than to treat it after it has occurred. Although most surgeons and anesthesiologists well appreciate the problem, there are those who hesitate and even object to giving blood during the operation because they are convinced that their surgical technic precludes large blood losses and often blame the anesthesia if shock does occur. It may be appropriate, therefore, to point out at this time that a review of the literature is impressive by the fact that all of the investigators concluded that (1) the blood loss is always greater than they had anticipated or estimated, (2) procrastination on the part of the surgeon in replacing blood loss during and after operations should be condemned, (3) accurate measurements and replacement not only affords the patient optimal prophylaxis and therapeusis but also leads to a better appreciation of the problem by the surgical team.

SUMMARY AND CONCLUSION

The replacement of blood lost during surgical operations is a very essential part of the operative procedure because it not only prevents shock but it also decreases the postoperative morbidity. In order to have optimal effects the blood must be administered as it is being lost and in proper amounts.

The gravimetric method affords the surgical team a simple and practical means of accurately measuring the amount of blood lost from the surgical wound. As there is usually additional blood lost into the tissue and in vessels just proximal to ligatures, the amount determined by the gravimetric method is the minimal amount to be replaced.

The blood loss has been determined by the authors in 748 surgical procedures which are presented herein. The average blood loss as found by seventeen other investigators is also presented.

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ADENOMAS of the parathyroid can cause kidney complications because the secretion of these benign growths increase serum calcium and lower serum phosphorus levels. In either case an increase occurs in the amount of these minerals in the urine. It is for this reason that many prominent urologists suggest that all patients with renal calculi be checked for possible parathyroidism first. If present, their parathyroid tumor should be removed prior to treating the patient for his kidney stones, unless an acute obstruction to renal secretions is present, caused by said calculi. (*Richard A. Leonardo, M.D.*)

PHOTOGRAPHS, INFRARED PHOTOGRAPHS AND TRANSILLUMINATION DIAGRAMS ILLUSTRATING DIAGNOSIS AND TREATMENT OF THE CERVIX UTERI

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MUCH is written today on early detection of cervical cancer. This paper presents a more important subject, cancer prevention, in pictorial form.

An article by Charles F. Bowen[1] and a pamphlet on infrared photography obtained from the Eastman Kodak Company[2] guided us in our photography.

Transillumination of the cervix has been of interest to the writer since 1926, at which time he published a short article on the subject.[3] In July, 1944, *The American Journal of Surgery* published an editorial by the writer on the significance of transillumination of the cervix uteri.[4] Davis' book, "Gynecology and Obstetrics," in a section written by L. A. Emge[5] gives a short account of cervix transillumination.

These methods of portraying the cervix are brought together to demonstrate the changes to which the cervix is subject and to demonstrate one way of eliminating the bed in which cervical cancer is usually born.

The ideal way to present the subject of diseases of the cervix would be in colored photographs. However, it was found that the essential details could be brought out in black and white photographs by proper selection of films as used in an adequately designed camera. Colored film may be satisfactorily reproduced in black and white if a red insensitive film is used. (Fig. 1.) Film with similar characteristics may be used to take direct photographs of the cervix. (Fig. 2.) (Verichrome, Ansco Ortho, and Dupont Defender D. F. Ortho are satisfactory.)

To demonstrate cervical pathology pictures must define areas covered with columnar epithelium, areas covered with squamous epithelium, blood vessels, cysts, deposits of pus and lacerations. In the artificial light type of colored film squamous epithelium has a large amount of blue in it. The black and white film, which is insensitive to red, is quite sensitive to blue and other colors reflected from the cervix or present in the colored film.

Columnar epithelium is a strong red and appears as such in the colored film. In the black and white film, which is insensitive to red, the red of columnar epithelium makes no impression, so in the print "erosions" appear as very dark areas. (Fig. 2.) This provides strong contrast in the pictures. Cysts appear as dark areas in the prints. Deposits of pus are white. (Fig. 3.) Blood vessels appear as dark streaks.

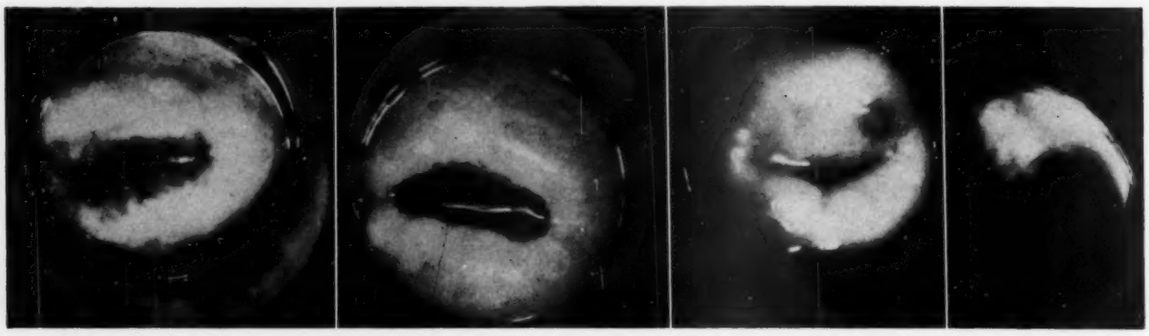
It was hoped that pictures of the transilluminated cervix could be taken which would satisfactorily demonstrate transillumination. However, only a small segment of the cervix can be photographed satisfactorily with transmitted light. (Fig. 4.)

Infrared photography was tried and found to be partially successful in demonstrating the cysts and other pathologic conditions which can be discovered otherwise only by transillumination. (Figs. 5A, 5B and 6.) Infrared film is sensitive to light coming from cervix tissue except that from cysts and blood vessels. The prints are predominantly white with dark areas representing cysts, dark streaks for blood vessels and very white spots for deposits of pus cells. Surface detail is poor.

This is a satisfactory means of recording the presence of superficial cysts but it fails to indicate many of the cysts which are buried a little more deeply and which can be detected by transillumination. It is of value in demonstrating that cysts are exceedingly common and that they are present in places where ordinary examination fails to detect them. It also helps to show that a white spot on the surface of the cervix usually indicates the presence of a cyst with a deposit of pus cells or debris.

Infrared photography is disappointing for demonstration of blood vessels. It seems to be inferior to color film for this purpose.

To take infrared pictures Eastman infrared film was used. Wratten filter No. 88A was placed in holder K. (Fig. 7.) Otherwise the



1 2 3 4

FIG. 1. Laceration with columnar overgrowth; no cysts; print from colored photograph using red insensitive film.
FIG. 2. Erosion; direct photography with black and white film, insensitive to red.
FIG. 3. Infrared film; black area of cyst with white spot due to sediment of pus in center of cyst.
FIG. 4. Cysts outlined by transillumination.

5A 5B 6

FIG. 5. A, infrared film; massive collection of cysts; B, transillumination diagram to show distribution of cysts.
FIG. 6. Infrared film; blood vessels show as dark streaks.

technic was the same as for black and white film.

Because black and white photographs and infrared photographs reveal only part of the pathologic condition visible by transillumination, they are supplemented in this article by transillumination diagrams. Some of the most grossly diseased cervices are not included in this presentation because they were too large to fit into the speculum which is part of the camera.

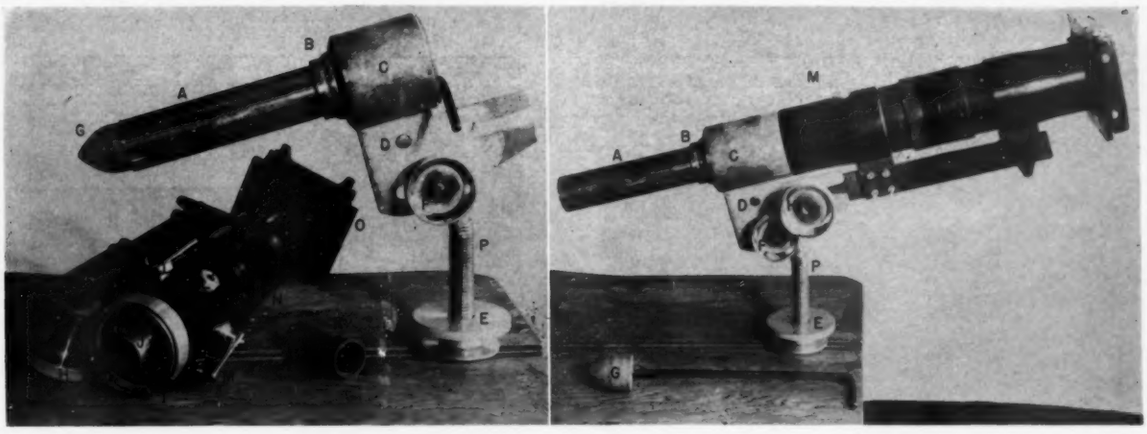
THE CAMERA

Using Bowen's article[1] as a guide P. H. Jones, research chemist, constructed the camera used to make the photographs shown in this article. Jones's description of the camera follows (Figs. 7 and 8):

"The camera consists essentially of two major parts, the speculum assembly and the camera proper. This arrangement permits use of a light weight speculum tube that can be manipulated easily during insertion, and then clamped in any desired position. The camera proper can then be readily attached, and the exposure made rapidly.

"The speculum tube shown at 'A' (Figs. 7 and 8) consists of a polished 18 gauge stainless steel tube about 6 inches long, and 1½ inches outside diameter, with rounded edges at one end and loose fitting threads at the other, for attachment to a stainless steel ferrule 'B' which is firmly threaded into the aluminum housing 'C'. Thus the speculum can be easily removed from the apparatus for cleaning and sterilization. The angle of the speculum to the horizontal can be adjusted, by rotation around pin 'D'. The final position of the apparatus with respect to angle, height above table and longitudinal location can be fixed at will by adjusting clamps 'E' and 'F'. A loosely fitting aluminum obturator 'G' has been found useful in inserting the speculum tube.

"The camera proper is attached to the specu-



7 8

FIG. 7. Camera and speculum with supporting stand, separated.
FIG. 8. Camera attached to speculum.

lum assembly by clamp 'H'. Entry of outside light is prevented by matching grooves and ridges turned into the abutting ends of the camera and housing 'C'.

"Twelve very small 6 volt automobile dash board type lights 'I' are arranged in a ring in the speculum end of the camera proper. Light can enter the speculum tube to illuminate the cervix, but its entry into the back of the camera is prevented by a ring supporting the lights and a thin-walled tube 'J' about 1 inch in diameter attached thereto, which fits inside the ring of lights and extends toward the speculum about ½ inch beyond the lights. Filters can be placed in filter holder 'K' which fits into tube 'J'.

"Electric current for lighting is brought through the walls of the camera tube by spark plug type connectors 'L'. The light holder ring is completely insulated from all metal parts of the apparatus and a heavy ground wire to protect against possible short circuits, leads from the bottom of the threaded speculum support bolt to a convenient water pipe.

"The lens is a coated Tessar with a focal length of 6½ inches and an aperture of f 4.5. There is no shutter, but the aperture can be controlled by a conventional iris diaphragm. However a simple system of lever linkages is required to bring this control to the exterior of the camera at lever 'M'. The lens is mounted at the back of the tube extending through the ring of lights. Focusing is obtained by rotating collar 'N' which couples the two tubular ends of the camera by right hand threads on one end and left hand threads on the other.

"A regular Graflex adapter 'O' for taking 2½ by 3¼ inch cut film holders is fixed to the back end of the camera.

"The lights are energized by A.C. current from an "American Flyer" toy train transformer which, in turn, is connected to the regular 115 V. A.C. supply. Focusing is done with the lens aperture set at f 4.5 and the transformer set to provide a low voltage. Exposure is made at an aperture of f 6.3 with the transformer set to provide a higher voltage. Time of exposure is controlled by an Electronic Photo timer model T M 5 made by the Lektra Laboratories Inc. Exposure requirements vary from 5 to 11 seconds depending on the type of film being used."

This camera has the following advantages: It eliminates motion; the speculum and camera are automatically aligned; outside light is excluded; and, as the cervix occupies an almost constant relationship to the speculum, very little attention to focusing is necessary. A minimum of time is needed to take the desired pictures.

THE TRANSILLUMINATOR AND ITS USE

The writer uses a modification of the Carroll transilluminator.* The handle of the light is bent to carry the battery handle and examiner's hand out of the line of vision. A right-angled light with a hooded globe is used to throw light into the cervix. (Fig. 9.) The position of the light and its intensity may be varied until the examiner has a complete picture in his mind

* Made by the Boehm Instrument Co., Rochester, N. Y.

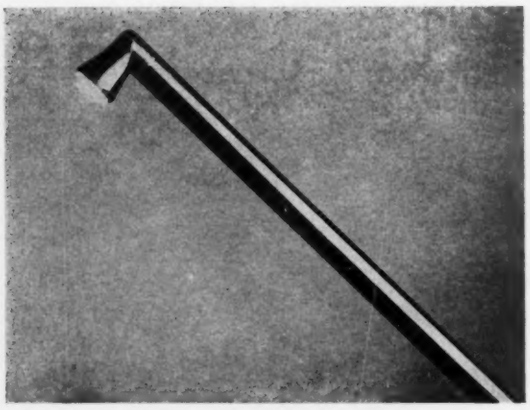


FIG. 9. Transillumination light.

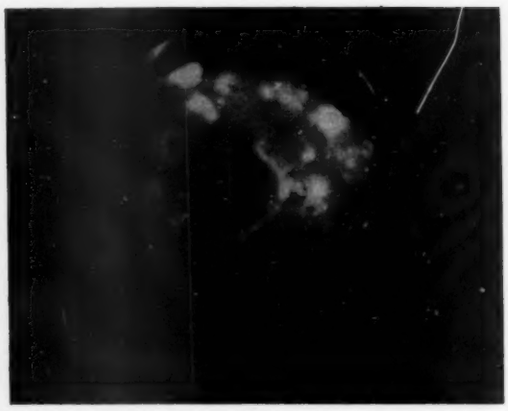
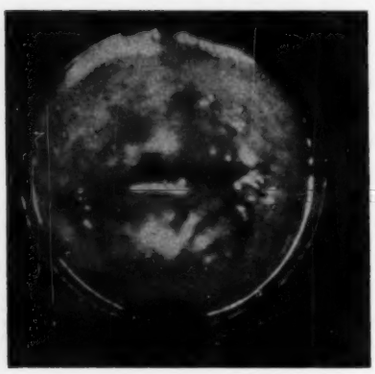
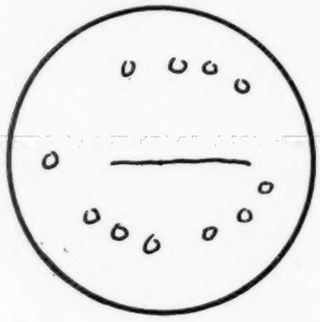


FIG. 10. A very cystic cervix amputated and transilluminated; clear areas are cysts; black spots over clear areas are deposits of pus or debris in cysts.

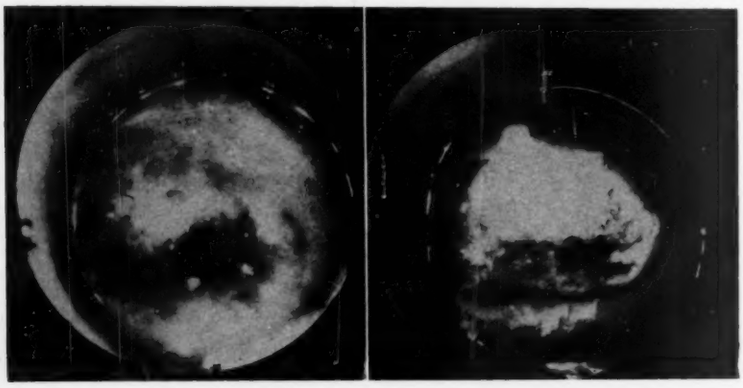


11A



11B

FIG. 11. A, cervix soon after delivery; B, transillumination diagram of Figure 10A to show beginning cyst formation at periphery of erosion.



12A 12B

12C

FIG. 12. A, laceration with partially healed erosion; B, coagulation of area of epithelial conflict as defined by distribution of cysts; C, distribution of cysts; broad area of epithelial conflict.

of the discoverable pathologic condition. It is very helpful to make a diagram as the transilluminator is being used.

Cysts appear as clear red areas. A cyst often has a sediment of pus cells which appears as a dark spot against the clear background of the cyst. Blood vessels appear as dark streaks. Superficial cancer is slightly more luminous than normally covered cervix. Hemorrhage or necrotic tissue associated with cancer, when transilluminated, makes dark shadows. Polyps, if cystic, are translucent.

The strong light of the transilluminator as it is moved into position for transillumination brings out surface details which can be seen plainly in the photographed cervix. (Fig. 10.)

SIGNIFICANCE OF TRANSILLUMINATION

Examination as described in this paper reveals the *area of epitbelial conflict* which the writer considers important in the prophylaxis of cancer. Parturition leaves the external os relaxed and often lacerated. Hypertrophic endocervical mucosa fills the cervix and often overgrows the portio at the expense of the squamous covering during the period immediately after delivery.

As the uterus recovers, the activity of the columnar epithelium subsides and the mucus secretion decreases. This allows the squamous epithelium to spread over and into the area filled with columnar epithelium and mucus glands. Plugging of glands occurs as this takes place, producing cysts. This explains the circle of cysts which is so commonly seen at the edge of an erosion. (Figs. 11A and 11B.) With the passage of time and the advancement of the squamous epithelium to the external os the previous site of erosion may be studded with cysts (Figs. 12A and 12C) or may be packed solid with cysts which are not seen through the squamous covering. (Figs. 5A and 5B.)

The current conception is that cancer develops at the juncture line of the two epithelial types. My concept is that the two types of epithelium are in conflict over an area instead of along a line. This area of epithelial conflict may remain indefinitely.

TREATMENT

This article was not planned to describe therapy; but as the pictures show the treated cervix, a brief statement of the writer's technic is given. (Figs. 12A, 12B and 12C.) Treatment consists of destroying the area of epithelial conflict and the erosions. The coagulating needle is thrust into discoverable cysts and the canal is usually treated also in the distal ⅓ inch. In this way the area in which cancer commonly develops is treated. Deeply buried cysts may be missed but are probably not of much significance.

Polyps are also destroyed by removal followed with thorough coagulation of the base and of any associated cysts or erosion.

Without transillumination, treatment very often leaves behind pathologic conditions. Patients are frequently told that the cervix is normal when transillumination would reveal it to have an area of epithelial conflict.

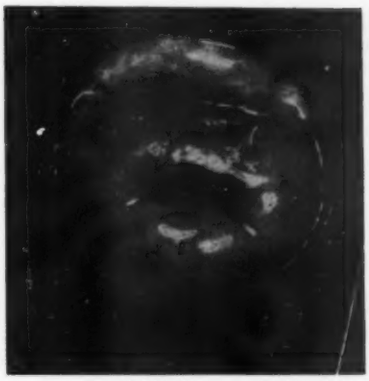


FIG. 13. Healed, treated cervix.

Adequate diagnosis and treatment fitted to the pathologic condition will leave the cervix healthy. (Fig. 13.) Years ago figures were produced to show that the adequately treated cervix was not apt to become cancerous.[6–9]

Cellular pathology as studied with the Papanicolaou stain is an important related subject. A preliminary vaginal smear is desirable to avoid inadequate treatment of hidden cancer.

CONCLUSION

The cervix should be examined after every childbirth and miscarriage, after operations involving the cervix and after acute infections. Transillumination and close inspection of the cervix should also be part of the annual physical examination.

It is hoped that this article will encourage others to make records of the diseased cervix. If the knowledge available now for the diagnosis and treatment of pathologic conditions of the cervix were universally used, the writer believes that the majority of those who die from cancer of the cervix would be saved.

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The incidence of proliferative solid and cystic tumors of the ureter have become greater as a result of better diagnosis and more frequent and thorough autopsy studies. The question of epithelial rests has always been a debatable one; the opinion of many modern investigators, however, seems to be that hyperplasia of this epithelium (as also that of the renal pelvis) may be the result of local irritation. This may be caused by some form of chronic inflammation; or it may be due to poisonous agents and viruses excreted by the kidneys from the circulation. (*Richard A. Leonardo, M.D.*)

INTRAVENOUS USE OF PITUITRIN FOR LABOR*

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Brooklyn, New York

PITUITRIN during labor dates back to 1909 when Blair Bell[1] first mentioned its use subcutaneously in three cases of postpartum hemorrhage with good results. Two years later Hofbauer[2] used pituitrin for the stimulation of uterine contractions during the first two stages of labor. He[3] later recommended the intranasal method of application because of the inherent dangers of the intramuscular or subcutaneous route. Following this discovery many modifications of this product were made in order to find the ideal agent which could be used in cases of prolonged labor. However, because of the impurities of the preparations, the lack of standardization and the unpredictable response of the uterus to this hormone, its use was limited. Frequently tetanic contractions of the uterus were observed resulting in impairment of the placental circulation and fetal death due to asphyxia. When injudiciously employed in cases of dystocia, rupture of the uterus was not uncommon. As a result of the maternal and fetal difficulties resulting from the indiscriminate use of this hormone disrepute was the inevitable fate of the agent.

In the past three years the use of pituitrin by the intravenous route was reported by Theobald[4] and Hellman,[5] the former using the hormone with good results both for inertia uteri and induction of labor.

Encouraged by these reports we have administered pituitrin or pitocin both for the induction of labor and for uterine inertia in a selected group of patients. Another phase of this study[6] included the recording of uterine contractions with the Reynold's strain gauge tocodynamometer both before and after the administration of pituitrin. This report is concerned primarily with the clinical course and observations of patients in labor; the laboratory phase is presented in the paper referred to previously.

MATERIAL AND METHOD

Of a total of 122 cases studied there were seventy-seven cases of uterine inertia and forty-five cases of induction. Of the seventy-seven cases of inertia uteri fifty-eight were primary and nineteen secondary. Of the primary inertia group forty-three were in primigravidas and fifteen in multigravidas. In thirty-four of the cases the membranes were intact and in twenty-four they were ruptured.

The strength of the solution varied between 1:10,000 to 1:5,000 and the amounts varied from 100 cc. up to 2,000 cc., with the majority taking less than 1,000 cc. The diluent fluid was either one-sixth molar lactate, 5 per cent glucose in normal saline or 5 to 10 per cent glucose in distilled water. The latter solutions were used for toxemia patients primarily.

In making up our solution either $\frac{1}{10}$ cc. or $\frac{2}{10}$ cc. of pituitrin or pitocin was placed in 1,000 cc. of diluent thereby making a 1:10,000 or 1:5,000 solution. The rate of flow was begun usually at twenty to forty drops per minute; but if the contractions were not effective, the rate was usually increased slowly up to sixty, eighty and finally one hundred drops per minute. The precise method of administration, its advantages and the precautions to be observed are expressed in another communication.[7]

Because of the unpredictable hyperirritability of the uterus in some of these cases in which a prolonged uterine contraction may be observed initially, the rate of flow was not increased for the first twenty to thirty minutes. Thereafter, the rate of flow was regulated by the clinical response which in the early stages was correlated with the tocodynamometer tracings from the lower and upper uterine segments. In a few cases in which there was very little or no response to the intravenous pituitrin, in a 1:10,000 dilution the infusion

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was stopped and the patient was given further sedation. With the resumption of the intravenous drip the resultant labor was progressive and delivery was effected. With the employment of stronger solutions (1:5,000) this initial refractoriness was not observed.

In a large number of cases in which the membranes were intact pituitrin was given. After varying periods of time the membranes were ruptured artificially. This seemed to enhance the oxytocic action and hasten the process of dilatation of the cervix considerably, delivery often taking place within a few hours.

In primary inertia the presentations included fifty-three by the vertex and five by the breech. Eleven of the vertex presentations were occiput anterior and forty-two were occiput posterior or transverse. Forty-nine of the patients had deliveries either spontaneously or by low forceps. Seven deliveries were by forceps rotation and in two cases cesarean section was performed. In the two cases in which abdominal delivery resulted a trial of labor of from four to six hours utilizing pituitrin for uterine stimulation was employed. Fifty-seven live babies were delivered; one of these showed a spina bifida. There was one stillbirth in which instance the mother had irregular pains for a few days and no fetal heart was heard on admission. The mother was Rh negative and the baby Rh positive. Before pituitrin was given the membranes were ruptured artificially and only 200 cc. of a 1:5,000 solution was required to effect cervical dilatation and delivery by low forceps. There were no neonatal deaths.

There were nineteen cases of secondary inertia of which fourteen presented by the vertex and five by the breech. Three were frank breeches and two were footlings. In the vertex presentations twelve were occiput posteriors or transverse and two were anterior. There were eighteen live infants and one stillbirth; no neonatal deaths occurred. Eleven infants were delivered either spontaneously or by low forceps. One 8 pound infant in frank breech position was delivered by cesarean section after a trial of labor and no progress. Another breech extraction resulted in a stillbirth in which the infant weighed 9 pounds, 4 ounces. There were six mid-forceps, one anterior position, one manual rotation and four forceps rotation.

INDUCTION OF LABOR

There were forty-five cases in which labor was induced. Of these, thirty-four were multigravidas and eleven primigravidas. Of the multigravidas eleven were gravidas II, seven were gravidas III and sixteen were gravidas IV to X. In twenty-seven of the cases the membranes were ruptured and in eighteen they were intact. The indication for pituitrin infusion in the majority of cases was spontaneous rupture of the membranes at or near term without any labor pains.

Special indications are listed as follows: three cases of premature separation of the placenta; two marginal placenta previas; one dead fetus at term; one antepartum bleeding at term of undetermined cause; one erythroblastotic infant in which induction was done at thirty-two weeks; one posterior face presentation with ruptured membranes; five hypertensive toxemias in the last trimester, all stabilized and one twin gestation.

There were thirty-four successes and eleven failures. The mode of administration and the solutions employed were the same as for inertia. In this group, however, from one to four attempts at induction were made in several cases.

There were six fetal deaths three of which were due to premature separation of the placenta, and in one case the fetus was dead on admission. In one hypertensive toxemia case in which four attempts at induction were made the fetal heart was absent before the last trial. There was one Mongolian idiot in this series.

Induction seemed to be most effective in cases at or near term in which the membranes had been ruptured spontaneously for varying lengths of time up to thirty hours before pituitrin was employed. In these cases the patients had experienced no spontaneous labor pains. With small doses of pituitrin in a dilution of 1:10,000 or 1:5,000, labor periods for the most part were rapid and satisfactory. In other suitable cases in which the membranes were intact on admission exhibition of pitocin for a short period of time followed with artificial rupture of the membranes resulted in successful delivery at or near term. The station of the vertex did not seem to be important, but the condition of the cervix and its negotiability played a role in our selection of cases. The long, rigid primiparous cervix was not generally an

indication for induction, but we noted a change in the consistency and length of the cervix after one or two infusion trials in several cases. We attempted induction in primiparas when we believed that the cervix was ripe, and in a few cases it was delayed until we thought that the cervix was prepared for labor. In these cases the condition of the cervix was followed with daily rectal examinations.

Infusion of pitocin or pituitrin was effective for induction of labor in premature separation of the placenta and marginal placenta previa and in one case of antepartum bleeding of undetermined etiology at term. In one case with a dead fetus at term and in one case which was induced for a rising Rh antibody titer in the mother at thirty-two weeks after artificial rupture of the membranes, delivery was successfully terminated by the infusion.

All deliveries were by the vaginal route except in one instance in which abdominal section was performed for a posterior face presentation in a primipara after three hours with ruptured membranes and pitocin infusion with no progress.

The following are the unsuccessful cases:

Case I. A gravida VII, para V, with ruptured membranes for thirty hours, was given intravenous pituitrin for two hours. Pain stopped shortly after the infusion was discontinued. The following day the patient had irregular contraction and a very tense uterus. Vaginal examination disclosed a cervix which was 4 cm. dilated and a contraction ring in the uterus. Adequate sedation was employed. After a short labor period the patient delivered spontaneously a normal infant fifty-seven hours after the initial pituitrin trial. Her previous labor had lasted for ten hours with irregular pains.

Case II. A primigravida was delivered by cesarean section from the right mentum posterior position after three hours of trial labor with pituitrin infusion and no progress. The pituitrin was used in the hope of facilitating rotation. A posterior face presentation is probably a contraindication for pituitrin.

Cases III and IV. One was a para III and the other a para I with twins, both with intact membranes. These patients were given ethnyl estradiol orally in doses from 6 to 24 mg. in an attempt to prime the uterus before pituitrin induction. We noted no difference in uterine activity or response to pitocin infusion while the uterine contractions were recorded with the tocodynamometer. The contractions ceased with discontinuance of the solution and the patients delivered spontaneously at a later date.

Case V. A gravida II, para I, with ruptured membranes for forty-eight hours, an undilated and uneffected cervix and a floating vertex, was given 500 cc. of 1:5,000 pitocin. The vertex descended to a minus one station, but the pains ceased on stopping the solution. The following day the patient delivered spontaneously after a short period of labor.

Case VI. A gravida IV, para III, at term with intact membranes failed to go into labor during the administration of a 1:5,000 infusion of pitocin and signed a release the next day.

Case VII. A gravida VI, para IV, with intact membranes had four trials and induction at the thirty-sixth, thirty-seventh, thirty-seventh and a half, and thirty-eighth and a half weeks with dilutions varying from 1:10,000 to 1:2,500. Two days after the last trial she delivered spontaneously a 5 pound, 6 ounce normal infant. In this case 13.5 mg. of estinyl employed for priming the uterus had no apparent effect.

Case VIII. A gravida IV, para III, at term with intact membranes was given 550 cc. of a 1:5,000 solution of pitocin intravenously with no resultant cervical dilation. The following day she delivered spontaneously.

Case IX. A gravida X, para V, at term with intact membranes and a 1 cm. dilated cervix was given two trials at induction with 1:5,000 dilutions forty-eight hours apart. The cervix was further effaced but dilatation was unaffected. She delivered spontaneously several days later.

Case X. A gravida II, para 0, hypertensive toxemic, controlled at term, had four attempts with intravenous pitocin or pituitrin for induction. She was given over 200 mg. of oral stilbestrol to prime the uterus. During the last infusion of 1:5,000 dilution of pitocin after the membranes had ruptured spontaneously, a tetanic contraction of the uterus was observed and recorded with the tocodynamometer. At this time the fetal heart dropped to 80 per minute, the pitocin was stopped and the fetal heart returned to 100 per minute and then to 120. The following day no fetal heart was present. Twenty-four hours later pitocin 1:5,000 was employed again with no further resultant dilatation, but some effacement of the cervix

was observed. Ergotrate in 1:1,000 dilution was employed intravenously for one hour. Two days later the patient delivered spontaneously a stillborn fetus.

CASE XI. A forty year old hypertensive cardiovascular, gravida II, para I, with intact membranes at term, failed to respond to a trial with 1:10,000 pituitrin and delivered spontaneously one week after a short labor period.

In reviewing our cases which were unsuccessful we noted that in some the infusion was not employed for a long enough period of time especially when the membranes were intact. With rupture of the membranes artificially the response seems almost assured with the proper selection of cases. If the cervix is hard and not fully effaced, repeated trials seem to cause effacement in some cases. In Case XI the patient had a spontaneous delivery at a later date after one attempt at induction failed; perhaps a second induction with artificial rupture of the membranes might have been successful.

Finally, there are those cases which should not be given pituitrin because the condition of the cervix and the uterus is such that they are not yet prepared for delivery. It is in these cases that perhaps the proper estrogen-progestin hormonal level necessary to prepare the myometrium for reception of the oxytocic principle of the posterior pituitary gland is not present.

COMMENTS

In a discussion of uterine inertia many vague terms appear. We are all familiar with the terms colicky pains, uterine inertia or atony, uterine dyskinesia, incoordinate uterine action, irregular or spasmodic action and partial contraction of the uterus. These terms attempt to denote the same condition which Jeffcoate[8] believes has the same etiologic factors (primiparity, nervousness and posterior position) and they require similar judicious treatment. The most common textbook description[9] of the etiology of prolonged labor lists three causes, namely, faulty development or diseased conditions of the uterine musculature; anomalies of its innervation and mechanical interference with its contraction.

We have divided the cases of uterine inertia into primary and secondary. The primary inertia cases are those in which the uterine contractions are weak, irregular and ineffectual in dilating the cervix sufficiently so that steady progress is observed toward completion of the labor within a reasonable time.

The term secondary inertia is intended to denote a period of labor in which the actual uterine contractions which were strong and forceful and sufficient to dilate the cervix to a certain point have become infrequent, weak and ineffective for one reason or another and the labor is arrested at that point.

Inertia may be the result of either spasm of the upper segment of the uterus or of the lower segment of the uterus and cervix. When there is a spasm or increased tonus in the lower segment of the uterus with inability of the cervix to dilate, it may be reflected[8] in the upper segment in the form of an inertia. This concept should be emphasized because functional resistance of the lower segment and cervix may cause the upper segment to contract feebly and incoordinately.

Further explanation of this fact has recently been demonstrated[10] by means of the strain gauge tocodynamometer. With this instrument it has been shown that for progress in labor to be observed clinically a work gradient must exist. The work performed in the upper uterine segment must be greater than the work resulting from the contractions in the middle segment; the middle segment work as evidenced by the strength and duration of the contractions must be greater than the lower segment. A disturbance in this relationship such as increased activity in the lower or middle segment results in lack of progress in labor.

In our observations on uterine inertia we have noticed that adequate electrolyte and fluid balance and sedation are necessary to enhance the action of intravenous pituitrin in this condition. This agent is extremely satisfactory in bringing to a successful termination cases of prolonged labor and in this way saving infants who might otherwise be sacrificed. In cases in which the membranes are intact artificial rupture in most cases appears to result in a more rapid dilatation of the cervix thus indicating a better response to pituitrin. While we employed very dilute solutions, namely, 1:10,000 to 1:5,000, by adjusting the rate of flow the amount of the oxytocic agent delivered per unit of time could be adjusted so as to be comparable to a more concentrated solution. The added advantage of the relatively weak solutions which have less tendency to produce tetanic uterine contractions is considerable. It

must be emphasized that when intravenous pituitrin is employed in uterine inertia, the flow of the oxytocic solution must be continued throughout the entire labor period for if the intravenous drug is stopped during the first stage of labor or before delivery is effected very often the labor ceases within a short period of time. No discernible damage to the infant with the possible exception of Case x was noted in our series.

We also have the distinct impression that the incidence rate of cesarean section when performed primarily for uterine inertia has been very definitely reduced.

Moreover, it appears that the urinary output is diminished during the administration of pituitrin. This is evidenced by the fact that catheterization was rarely necessary in these cases of prolonged labor. The pituitary antidiuretic factor undoubtedly accounts for this phenomenon.

When induction of labor was necessary or attempted, the proper selection of cases was essential for success. The cervical dilatation and its negotiability were the primary factors to be considered in patients at or near term. While the pituitrin solutions employed 1:10,000 and 1:5,000 dilutions were perhaps relatively weak, some compensation could be made by adjusting the rate of flow. It is to be noted that weak solutions are much safer than stronger solutions for the uterus in many cases seems to respond with strong initial contractions after only a relatively few drops of pituitrin have entered the blood stream. To prevent atonic and prolonged contractions with consequent fetal damage, a period of acclimatization of the uterine musculature to pituitrin seems to be necessary. After the first twenty to thirty minutes the strength of the solution may be gradually increased with little danger of prolonged uterine contractions.

With membranes intact the induction of labor with intravenous pituitrin is more difficult and slower. The rupture either spontaneous or induced enhances the progress and facilitates delivery.

In contrast to uterine inertia in which the progress of cervical dilatation seems to be uniform and at a gradual rate, the first stage of labor in cases of induction may perhaps be divided into two parts. It seems that the most difficult phase of cervical dilatation is up to about 3 to 4 cm. The time required to effect dilatation from 1 to 3 cm. appears to be several times that required for the dilatation to proceed from 3 cm. to full. This latter part of the first stage seems to be relatively short under pituitrin induction.

In several cases after the cervix reached 5 to 6 cm. we stopped the infusion and labor proceeded uninterruptedly. This appears to be in contrast to uterine inertia where cessation in the flow of the infusion results in failure of further cervical dilatation and labor comes to a standstill.

SUMMARY AND CONCLUSIONS

In inertia uteri many of these labors were relatively terminated promptly after the administration of intravenous pituitrin in this dilution. With this added obstetric facility at our disposal many long labor periods such as have been experienced in the past may be prevented in the future. We have used this modality as a trial of labor in a few cases and in instances in which a trial of labor is desirable, especially when the membranes are ruptured. This method was employed in order to arrive at an early decision as to the best route of delivery.

Electrolytic balance should be corrected and treated possibly before pituitrin is given. In these cases there may be better receptivity of the end organ, that is, the uterus, when it is in a normal physiologic state.

For the induction of labor at or near term when the membranes have ruptured spontaneously and the patient experiences no uterine contractions, the infusion of pituitrin or pitocin appears to be the ideal method. When it is necessary to induce labor in indicated cases near term, artificial rupture of the membranes and intravenous pituitrin are highly effective. The condition of the cervix in regard to dilatation, length and effacement is the determining factor in our selection of cases. The length of pituitrin–induced labors appears to be shorter than those with spontaneous onset.

Pituitrin in the amount and dilution used is not dependable in the immediate postpartum period to prevent or control bleeding. More concentrated solutions than those used in this study or other oxytocics are probably more effective for this purpose.

Although this method of pituitrin administration with its ease of control is relatively

safe, it must be emphasized that constant observation of the uterus and fetal heart is essential for the prevention of possible catastrophies.

Sufficient reasons for the employment of intravenous pituitrin were mentioned before. However, it is hoped that this method will not be used indiscriminately to cause it to fall into disrepute.

Addendum: Since this paper was submitted for publication, May, 1950, we have used pitocin infusions in an additional 300 indicated cases with the same excellent results as noted previously. There has been no evidence of deleterious effects on either the mother or child.

Acknowledgment: We wish to thank Dr. George Geanurocos for his compilation of the data from St. Catherine's Hospital.

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Chaulmoogra oil and streptomycin have produced satisfactory results in six cases of bilateral, inoperable tuberculosis of the kidneys and often of the lower urinary tract as well. The author justifiably recommends that this therapy be given a further trial in such cases. (*Richard A. Leonardo, M.D.*)

THE DIAGNOSTIC VALUE OF DIFFERENTIATING BETWEEN MORPHOLOGICALLY IDENTICAL CELLS BY TISSUE CULTURE*

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SINCE the invention of the microscope histopathology has made giant strides. Histochemistry,[1] the electronic microscopy, ultraviolet[2] and infra red studies are all contributing to our knowledge of the intimate structure and activity of the cell. We know that morphologically identical tissues which are of different origin may exhibit unduly different characteristics.[3] At an early stage of their embryonic life they have acquired already certain fundamental properties which they retain during their life cycle. We also know that under the influence of pathologic conditions cells may differentiate so that they become diagnostic of a particular disease. If, however, the fixed and stained tissues as seen through the microscope do not have these abnormal characteristics, the pathologists can only say that while they cannot exclude the disease there is no evidence to confirm it. Neither have we any way, at present, to affirm the potential activities of cells which at the time of an examination appear normal. Lymphocytes and monocytes from pleural effusion, whether caused by tuberculosis, Hodgkin's disease, pneumonitis, active or residual, have been undistinguishable from one another by our present histopathologic technic. But are they the same?

Those of us who are familiar with tissue culture know that tumors which look identical may grow quite differently in tissue culture. Greene[4] has shown that unidentified human tumors grown in the anterior chamber of the eye may differentiate so as to reveal their primary site of origin which could not be determined by histopathologic examination. The so-called "inflammatory" cells are no different in this respect from tumor cells.

One of us (C. T. B.) while studying a ward patient suggested that a tissue culture of pleural effusion might contribute to making the diagnosis when other methods had failed. A diagnosis of pleural endothelioma was made and autopsy proved the endothelial origin of the tumor. The disturbing element was the fact that histologically the tumor was found post mortem in the opposite pleura from which the pleural effusion was taken and on which diagnosis was made. The importance of this study lay, however, in the striking variation in the appearance of the cells in tissue culture forty-eight and twenty-four hours after culture, as compared to the cells in sections of the centrifuged fluid. The possibility that this method might help in the diagnosis[5] and prognosis of certain pleural effusion as it had been done by one of us (M. E. S.) for lymph nodes was enticing.[6] The case reports presented later will illustrate the use and limitations of the method.

Method. Pleural effusion is collected with the usual sterile precautions and 15 to 20 cc. collected in a sterile tube. Another 15 to 20 cc. are collected in a tube containing 1 cc. of heparin (equivalent amount which prevents the coagulation of 5 cc. cat's blood for twenty-four hours).† (Three to 5 cc. of fluid will sometimes suffice if no more is available.) The remaining pleural effusion is used for pathologic examination.

The fluid is centrifuged for ten minutes at 2,000 revolutions per minute and the supernatant removed to another tube. Using the Sano-Smith[7] tissue culture chamber the cells are grown in two types of medium. The one consists of two parts of autogenous plasma, one part of pleural effusion, one part of Tyrodes' solution and two parts of mouse embryonic

† Heparin used in these experiments was obtained from Hynson, Westcott and Dunning, Baltimore, Md.

* From the Department of Tissue Culture and Research Pathology and the Department of Medicine, Temple University Medical School and Hospital, Philadelphia, Pa. This investigation was supported by a grant from the National Cancer Institute of the United States Public Health Service and the Agnes Barr Chase Cancer Research Foundation, Temple University Medical School and Hospital.

extract. In the other medium the autogenous plasma is replaced by chicken plasma. The cultures are examined daily and examined at low, high power and under oil immersion which is possible by this method.

CASE REPORTS

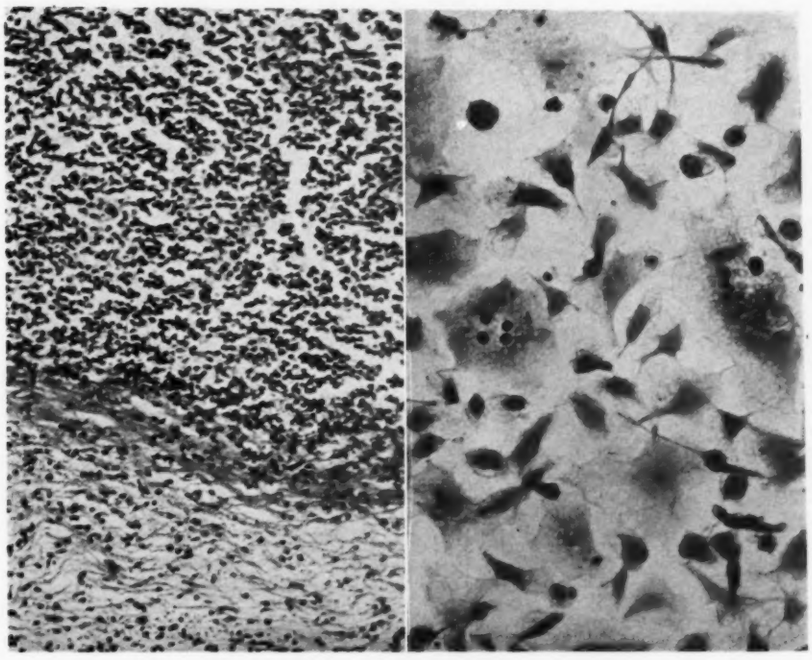
No. T144, a thirty-eight year old colored female, was admitted to Temple University Hospital with right chest pain. The history revealed a hysterectomy ten years ago. A lump was removed from the breast a year ago elsewhere; the diagnosis was unobtainable. X-ray revealed at time of admission several decalcifying lesions in the vertebral column. First x-ray diagnosis was that of metastatic tumor. Pleural effusion was bloody but showed no tumor cells. It consisted mostly of lymphocytes and a few monocytes. (Fig. 1.) Several taps were done. Cultures of pleural effusion were negative for bacteria including tuberculosis. At this time pleural effusion was collected for repathologic evaluation and tissue cultures. The cells on tissue culture were very active but more so in the human plasma pleural effusion media than in the chicken plasma alone.[8] The larger lymphocyte and monocyte showed well developed phagocytic activity. The cells grew larger, especially the undulating membrane of the monocytes. On the other hand, the small lymphocytes began to clump together. This was the state of the culture after the fourth day and little more attention was paid to it as no visible tumor cells could be identified. Before discarding the dishes they were re-examined, eight days after explantation. The human plasma dishes contained numerous giant cells. Some of these contained a slightly granular center around which were grouped more or less in a circle round nuclear-like bodies. Other cells had numerous oval bodies which were translucent in tissue culture. Besides the numerous giant cells there were elongated cells with pointed ends and oval nuclei resembling fibroblasts. Other shorter cells had rounded ends, suggesting epithelioid cells. The larger cells were definitely not tumor cells. Some appeared to contain phagocytised clumps of lymphocytes more or less fusing with their proper nucleus, the giant cells with the granular center, the aureole of round nuclei, the oval bodies suggested one cell, the Langhan's type of giant cells. (Fig. 2.) A tentative diagnosis of tuberculosis was made. Review of x-ray films supported the diagnosis of tuberculosis of an unusual distribution and character seen frequently in the Orient but rarely in the western hemisphere.

Meningitis developed and the patient died. Six weeks later the spinal fluid culture proved positive for mycobacterium tuberculosis (var. hominis).

The interest of this tissue culture is threefold, namely, (1) the appearance of giant cells. While it is possible to obtain such cells by artefact, the method of our tissue culture makes this a remote possibility. Pleural effusion of different origin has never produced such cells. The only time they were produced was in the presence of tubercle bacilli in a culture of active tuberculosis of a lymph node. Direct culture of the pleural effusion on Petragnini medium and tissue culture inoculation on a similar medium were negative for tuberculosis. The spinal fluid only gave the confirming diagnosis. (2) These morphologically similar lymphocytes and monocytes had unsuspected immediate potentialities of diagnostic value. (3) Fibroblast-like cells appeared confirming the supposition of Fisher[9] that in inflammatory conditions fibroblasts may assume the character of wandering cells. Whether these cells are true fibroblasts is open to debate although further experiments which will be reported at a later date would tend to confirm it.

No. T265, a white female, age forty-eight, had chest pain two weeks before admission. A diagnosis of pneumonia was made by the attending physician. X-ray of right chest on admission revealed pleural effusion. Pathologic examination showed only lymphocytes. Tissue culture of the fluid revealed lymphocytes showing little activity. A rare fibroblast was seen. Tissue culture diagnosis was that of a pleural effusion secondary to some undetermined cause which was retrogressive. After the thoracentesis the patient became well and was discharged one week later. The patient has been well since. (Figs. 3 and 4.)

No. T359 was a white female, aged sixty-eight. Routine pleural effusion diagnosis on admission was lymphocytes, monocytes and no tumor cells. (Fig. 5.) Tissue culture examination within twenty-four hours showed unusually rapid growth. (Fig. 6.) Many large cells with bilobed and trilobed nuclei were noted. Many of these resembled reticulum cells. Some of the lymphocytes showed mitosis. Several binucleated fibroblast-like cells appeared nor-



1 2

FIG. 1. T 144, centrifuged pleural effusion. Hematoxylin and eosin stain, × 200.
FIG. 2. T 144, tissue culture; note the giant cells. Trichrome stain, × 200.
Diagnosis by tissue culture, tuberculosis; clinical impression, metastatic carcinoma; x-ray, metastatic carcinoma; confirmed diagnosis, tuberculosis.

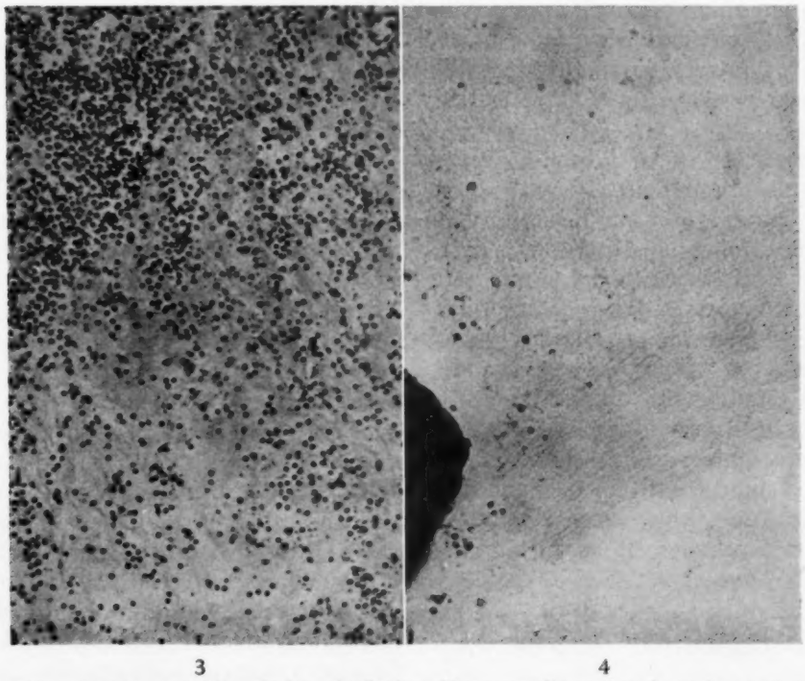


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FIG. 3. T 265, centrifuged pleural effusion. Hematoxylin and eosin stain, × 200.
FIG. 4. T 265, tissue culture (unstained), cells were immobile, degenerative. × 200. Diagnosis by tissue culture, no tumor cells; clinical, x-ray, tumor? Patient well two years later.

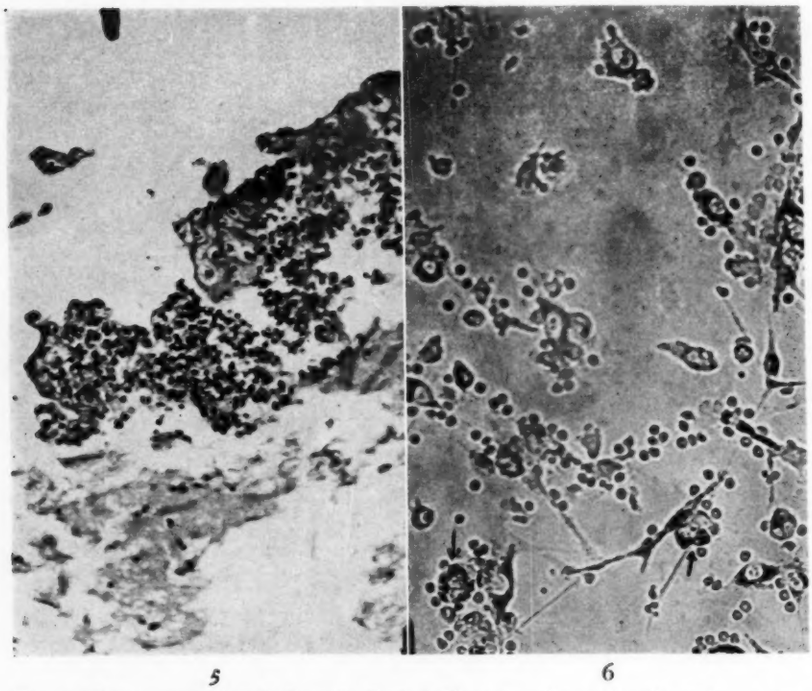

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FIG. 5. T 359, centrifuged pleural effusion. Hematoxylin and eosin stain, × 200.
FIG. 6. T 359, tissue culture (unstained); note cells with trilobed nuclei. × 200.
Diagnosis by tissue culture, reticulum cell sarcoma with some of the characters of lymphosarcoma.

mal, however. The diagnosis on tissue culture was reticulum cell sarcoma with some of the characteristics of lymphosarcoma. Lymph node biopsy done two weeks later confirmed this diagnosis.

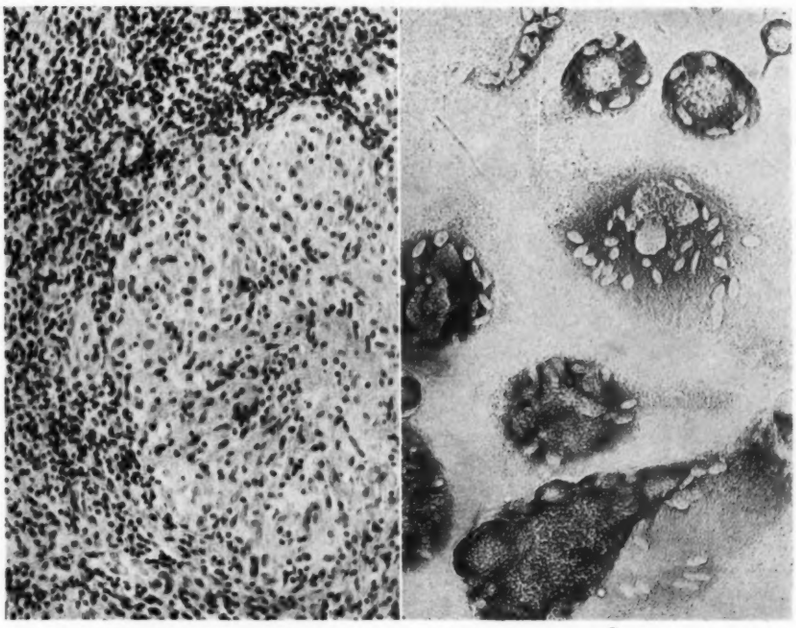
Case No. T277 serves to illustrate better perhaps any of the stupendous different potentialities which can exist in similar cells. The patient was a colored female, age forty-eight, known to have Boeck's sarcoid. Lymph node biopsy showed the classic picture with occasional giant cells containing asteroid bodies. (Fig. 7.) Growth in tissue culture at first showed mostly lymphocytes, monocytes and a few epithelioid cells. Three days later most of the cells had grown larger. In five days the culture consisted almost entirely of giant cells of fantastic magnitude. They exceeded both in behavior and in size as well as in number anything that we have as yet seen. (Fig. 8.)

COMMENTS

Additional cases could be presented to illustrate the point in question but they would only encumber the paper. Fifty pleural effusion cases alone have been made since this paper was written and only emphasize the diagnostic and academic value of the method.

The surgeon and the clinician is frequently confronted by idiopathic pleural effusion or by lymph nodes in which the histology of the cells show no pathologic tendencies. Tissue culture could frequently give him further practical information. Tissue culture, with dried medium soon available, should soon become a routine procedure in all well organized laboratories although for diagnostic purposes autogenous plasma should be used. Its difficulties have been grossly exaggerated and for our purposes the more difficult technic of transplantation need not be embarked upon. In fact the purpose is to identify the immediate potentialities of the cells not what they will eventually revert to after they have been withdrawn from the abnormal causative influences.

The inquisitive and more adventurous tissue culturist will be frequently rewarded by producing entirely unsuspected diagnosis; for example, that of tuberculosis in which the history and the first clinical and x-ray diagnosis was malignant tumor. In reporting this case



7 8

FIG. 7. T 277, lymph node section of Boeck's sarcoid. Trichrome stain, × 200.
FIG. 8. T 277, in tissue culture (unstained); note unusual size of giant cells. × 200.

we mentioned that Koch's bacilli were not isolated from the pleural effusion. Of course, we realize that this is far from absolute proof of their absence. However, it indicates that the work of Lewis and Lewis[10] who have studied the formation of the Langhan's giant cell and that of Heilman and Seibert[11] who have analyzed the effect of the different chemical constituents of the tubercle bacilli on cells should be further correlated with clinical observations.

The clinician, therefore, in requesting tissue culture is not only helping to establish a correct diagnosis but also he is stimulating research of a very practical as well as theoretic kind. Not only that but he may also sometimes receive surprising information which may guide his treatment and benefit the patient. The particular case we have in mind was that of a male patient with Hodgkin's disease diagnosed as such by section of a lymph node. The patient was given three x-ray treatments but his condition was rapidly downhill and he became delirious. While the histopathology was characteristic as was the history, there was one clinical discord. The temperature was not of the usual fluctuating (Pel-Ebstein) type but of the "continuous fever" type vacillating around 103°F. In tissue culture after three days, long chains of bacteria were seen growing in symbiosis with the cells. They proved to be hemolytic streptococci susceptible to penicillin. After penicillin treatment the patient's temperature dropped and assumed the oscillating type of temperature associated with the Hodgkin's syndrome.

The method at first gave some unsatisfactory results in cases of pleural effusions coming from advanced cases of malignancy where histopathologic diagnosis was evident. This is not surprising in view of all the toxic substances present which the favorable medium in tissue culture is apparently unable to counteract. Washing away the erythrocytes with Tyrode solution has greatly increased the growth. The method is intended primarily for the enigmatic cases. And, we are the first to admit it, occasionally no additional information will be gleaned from the tissue culture.

However, until chemical analysis of the nucleoproteins and the cellular enzymes are established which may perhaps enable us to distinguish between tumor cells and normal cells we offer tissue culture as another diagnostic weapon.

SUMMARY

1. Morphologically identical cells under different pathologic influences possess different

characters which may be demonstrated in tissue culture.

2. Four cases are presented, three are pleural effusions, one a lymph node. Microphotographs illustrate the point.

3. The tissue culture method may reveal unsuspected conditions and occasionally incidental bacteriology of interest to the welfare of the patient.

4. The method opens new fields in correlative studies of cause and effect in disease of both practical, theoretic and fundamental value.

Acknowledgment: We are indebted to Dr. E. S. Gault for all the photomicrographs. We are also indebted to the Department of Pathology for slides of Figs. I, III and V and to the Department of Medicine and Surgery for their excellent cooperation.

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PROLONGATION OF SPINAL ANESTHESIA (75 TO 100 PER CENT) WITH LEVOPHED* INTRATHECALLY

A PRELIMINARY REPORT

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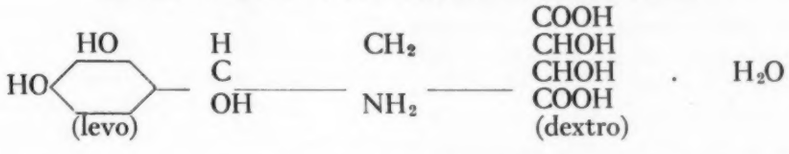
MORE spinal anesthetics are administered by surgeons and general practitioners than by physicians whose work is limited to anesthesiology. The physician whose practice is primarily in some field of medicine other than anesthesia has no doubt wished many times for some substance that could be added to the spinal anesthetic drug to prolong its action. The continuous spinal methods of Lemmon or Tuohy are satisfactory for long spinal anesthesia but both require special equipment which may not be readily accessible to the physician doing part time anesthesia.

Since the work of Donitz[1] in 1903 a search for a safe and effective way of prolonging the duration of spinal anesthesia has been sought. Epinephrine, a sympathomimetic drug, was the first used by the early investigators[1,2] to prolong stovaine and cocaine spinal anesthesia. The workers[3] of that time believed that while intrathecal epinephrine prolonged the duration of spinal, the ischemic effect on the nerve roots made its use of questionable safety. Interest waned until Romberger[4] in 1935 reported using epinephrine intrathecally in 1:1,000 concentration with the spinal anesthetic drug. This he soon discontinued because of the slow onset of the anesthesia and the possibility of ischemia to the nerve roots. Reports[5–8] appearing in the recent literature on the use of the vasopressor substances, epinephrine or ephedrine intrathecally with the spinal drug are confusing in that some report prolongation while others claim none. Favorable reports[9,10] using neosynephrin as the prolonging agent with pontocaine and dextrose have appeared most recently.

Barger and Dale[11] as early as 1910 suggested the sympathetic effector substance might be a catechol with a primary side chain rather than epinephrine. The work of numerous investigators[12–17] since then have pointed to dihydroxy-phenylethonalamine (arterenol, norepinephrine, noradrenalin) as the substance in question. Assuming that the true hormone is arterenol, it follows that the l-isomer rather than the d-isomer or racemic mixture is generally more active. After years of effort on the part of many investigators, arterenol was resolved into its levo and dextro rotary isomers.

CHEMICAL AND PHYSICAL PROPERTIES OF LEVOPHED



Levophed is levo-arterenol dextro-bitartrate monohydrate, which has a formula of $C_8H_{11}NO_3$ $C_4H_6O_6$ H_2O.

Levophed is soluble in water to the extent of 20 per cent at 25°C. The pH of a 1 per cent solution is 3.4. It is supplied by the manufacturer in ampules of 4 cc. of 1:1,000. Ampules of 1 cc. containing 2 per cent novocain with levophed 1:50,000 or 1:20,000 were used intrathecally in this study to prolong single dose spinal anesthesia.

METHOD OF STUDY

The spinal analgesia produced by using pontocaine, dextrose and levophed intrathecally outlasted the surgery in most instances. It was,

*Levophed® was known as levophen during the experimental period. The drug was generously supplied by the Medical Research Department of Winthrop-Stearns, Inc., N. Y.

therefore, necessary to use other means of determining the time at which the analgesia was no longer effective for surgery. Four tests seemed practical in properly evaluating the duration offered by this combination of drugs. (1) How long was it possible to operate? (2) How soon did leg motion return? (3) When did pressure on the operative site cause subjective pain? (4) How soon did subjective pain return? Each patient was followed closely and the following additional data were recorded: dosage of drugs used, technic of administering spinal and level of the anesthesia, effectiveness of the anesthesia, vasopressors used to sustain blood pressure with dosage and mode of administration, duration of operation, operative procedure and supplementary anesthesia.

TECHNIC

Of the many accepted methods for administering spinal anesthesia each anesthesiologist has his own technic, which produces the best results in his hands. No change in spinal technic is suggested for the addition of levophed to the customary routine of the anesthesiologist will probably produce equally good results in prolonging spinal anesthesia. A rather fixed dosage and technic was deliberately adhered to in this study so that the results would be more standardized. For upper abdominal operations liquid pontocaine 15 mg. (1.5 cc.), dextrose 10 per cent (1.0 cc.), levophed 0.045 mg. and spinal fluid (1.0 cc.), making a total volume of 3 cc., was gently and slowly (¾ cc. per second) injected in at the third to fourth lumbar space. This usually produced a skin level to the seventh or eighth thoracic vertebrae, with little or no Trendelenburg.* The third technic used was for rectal or pilonidal surgery in which the patient was in a jackknife position. For these patients 4 to 6 mg. (0.4 to 0.6 cc.) of liquid pontocaine with levophed, 0.038 mg. was made up to 4 or 6 cc. volume with distilled water, and the patient was instantly put in jackknife position. Later in the series this type of case was discontinued, for a long operating time above that easily obtained by pontocaine alone was rarely needed. Hypobaric technic produces anesthesia ideally suited for surgery in this area in the jackknife position.

Of the pontocaine levophed group in which upper, lower and extra-abdominal surgery was done, the operation did not outlast the anesthesia in any case. (Tables I and II.)

TABLE I
PONTOCAINE-LEVOPHED
FIFTY CASES

Hours	0–2		2–4		4–6		6–8	8 Plus
	0–1	1–2	2–3	3–4	4–5	5–6		
Duration of operation	30%	48	10	8	4	0	0	0
Duration of anesthesia pain on pressure	0		6	24	34	24	10	
Return of leg motion	40	2	2	32	16	10	0	0

TABLE II
TYPES OF OPERATIONS IN FIFTY LEVOPHED PONTOCAINE GROUP

Upper abdominal	Hernia, ventral	1
	Sympathectomy	6
	Gastric resection	2
	Cholecystectomy	5
	Nephrectomy	4
		18
Lower abdominal	Hernia	13
	Abdominal perineal	1
	Hysterectomy	1
		15
Extra-abdominal	Pilonidal excision	2
	Hemorrhoidectomy	5
	Trans-urethral resection prostate	1
	Hip-nailing	1
	Vein ligation	3
	Miscellaneous	5
		17

Supplement to these was only relative for anesthesia was adequate, but with heavy traction three of this group were given intravenous nembutal® in doses of 100 to 200 mg. for comfort. Pain did not return to the operative site until after three hours in 92 per cent and not until after five hours in 34 per cent of this group. Return of motion to the extremi-

* For lower abdominal operations liquid pontocaine 10 mg. (1.0 cc.), dextrose 10 per cent (1.0 cc.), levophed 0.045 mg. and spinal fluid (1.5 cc.), making a total volume of 3 cc., was injected.

ties was noted slightly sooner than subjective pain in the longer lasting anesthetics of the upper abdominal and lower abdominal group.

In those in which extra-abdominal surgery (mostly rectal and pilonidal) was done the legs retained motion throughout for most of these received a hypobaric anesthesia solution intrathecally and were immediately placed in jackknife position. Other observations not yet mentioned follow: Usually motor sensation returned before sensory. In longer upper abdominal surgery the return of muscle tone sometimes disturbed the surgeon before the return of sensory sensation bothered the patient in which cases curare was effectively used. The delay in setting up was not as much with levophed as with neosynephrin, intrathecally, in a previous series[10] although there was a slight delay in fixation. Pressure on the operative wound brought pain just prior to the return of subjective pain. Minimal postoperative care and analgesia was required except in those who had received intravenous nembutal.® On the return of subjective pain these patients frequently reacted in a disoriented manner characteristic of those with pain in the presence of barbiturates. Increased incidence of catheterization was noted, except in patients in whom early ambulation was carried out.

Table III
CONTROLS—(PONTOCAINE ONLY)
FIFTY CASES

Hours	0–2		2–4		4–6		6–8	8 Plus
	0–1	1–2	2–3	3–4	4–5	5–6		
Duration of operation	7	21	21	1	0	0	0	
Duration of anesthesia (pain on pressure)	18		29	3	0	0	0	
Return of leg motion	3		36	11	0	0	0	

Although it is not shown in these tables, 0.038 mg. of levophed was found to be less effective than 0.045 mg. for prolonging spinal anesthesia for upper or lower abdominal operations. Levophed in dosage of 0.038 mg. proved adequate in extra-abdominal surgery in hyperbaric, hypobaric or isobaric mixtures of pontocaine.

A control group (Table III) of fifty pontocaine dextrose spinal anesthesias alone is included in this paper so that results can be compared with the series of fifty to which levophed has been added. Also, fifty patients having received novocain levophed were studied. (Table IV.)

Table IV
NOVOCAIN-LEVOPHED
FIFTY CASES

Hours	0–½	½–1	1–1½	1½–2	2½ Plus
Duration of operation (per cent)	8	52	32	8	0
Duration of anesthetic (pain on pressure)	0	12	44	40	0
Return of leg motion	24	8	44	24	0

The types of surgery done on this group and the number of each is shown in Table V. This group was given levophed 0.045 mg. with novocain in one of three doses, 150 mg., 100 mg. or 50 mg., depending on the type of surgery to be done, size of patient and other factors influencing dosage of any spinal drug.

Table V
NOVOCAIN-LEVOPHED
FIFTY CASES

Inguinal herniorrhaphy	16
Trans-urethral resection prostate	12
Hemorrhoidectomy	6
Saphenous vein ligation	4
Miscellaneous operations on lower extremities	12
	50

Levophed was found in the pontocaine series to be effective in hypobaric, isobaric or hyperbaric mixtures so on the novocain group it was used in the mixture best suited for the particular operation. Table IV shows the findings on the novocain levophed (fifty cases). It was noted in the novocain series that one could not be as certain of a prolonging effect as in the pontocaine group. In 32 per cent the operation exceeded one hour without a supplement. In 44 per cent leg motion returned in one to one and a half hours and in 12 per cent, one to one and a half hours. Of course pain returned sooner in the patients who had had rectal or extremity surgery. Leg motion was

never abolished in some and of course returned sooner in the small dose lower level anesthesias.

An all-inclusive summary shows what may be expected with pontocaine levophed. (Table VI.)

TABLE VI
WHAT MAY BE EXPECTED WITH PONTOCAINE-LEVOPHED
FIFTY CASES

Dosage	Pontocaine Mg.	Levophen Mg.	Operating Time Available (hr.)	Anesthesia Time	Return Motion
Upper abdominal[18]	15	0.045	3½ to 4½	4 to 5	4 to 6
Lower abdominal[15]	10	0.045	4 to 5	5	3 to 5
Extra abdominal[17]	4 to 7	0.038	3 to 4	4 to 5	Motion throughout

Contraindications. Levophed need not be added in short operative procedures. Its routine use is unnecessary. It should not be used in patients for whom spinal anesthesia is not the choice.

Indications. Indications for the use of levophen are as follows: surgery in which spinal anesthesia is indicated and in which the duration of surgery may exceed the operating time ordinarily expected from a single spinal anesthesia technic; spinal anesthesia of the upper abdomen when surgery is to be longer than one and a half to two hours; in a busy operative schedule in which there is not time to set up continuous spinal anesthesia; when no continuous spinal equipment is available; for prolonged postoperative analgesia, when advisable. The total dose of spinal drug is less when this sympathomimetic substance, levophed, is used intrathecally.

COMMENT

The routine use of a vasopressor substance such as levophed is not advocated for all spinal anesthesia. Used intrathecally with pontocaine it effectively prolongs 75 to 100 per cent the spinal analgesia time usually expected. Levophed did not in this series prolong novocain spinal anesthesia 75 to 100 per cent but this could be due to technical difficulties rather than the drugs. Levophed for prolonging spinal anesthesia is of distinct advantage in upper abdominal procedures such as gastric resection when, with pontocaine, four hours' operating time are available with a single injection technic. It is useful for any surgery which necessitates a long procedure and in which spinal anesthesia is the method of choice. As in any spinal anesthesia a fall in blood pressure occasionally occurs but is slower in coming on. This delay in fixation indicates that the patient should not be subjected to moderate or severe positional changes for twenty to thirty minutes following injection.

In this series the age group consisted mostly of patients over fifty years of age and no sequelae referable to the nervous system were noted. Bray and Adriani[18] claim that neurologic sequelae are no more frequent when vasoconstrictors are used intrathecally than when they are omitted. This study agrees with these findings.

This paper is not a conclusive report but rather a preliminary one on the use of levophed as a prolonging agent in a limited number of spinal anesthesias. It is hoped that it may serve as a stimulus to further investigations of this drug, levophed, for prolongation of spinal, regional or infiltration anesthesia. It was effectively used during this study (not reported) to prolong (100 to 200 per cent) brachial plexus block and this phase should be studied. The drug, levophed, is worthy of extensive investigation to establish its place in the armamentarium of the anesthesiologist.

SUMMARY

In this study 150 patients were studied under spinal anesthesia. Fifty were given pontocaine only for spinal anesthesia as controls. Fifty were given pontocaine spinal anesthesia to which levophed had been added and fifty were given novocain spinal to which levophen had been added in order to study its prolonging effect.

It is possible to increase the usual length of pontocaine or novocain anesthesia 75 to 100 per cent by the addition of levophed in amounts of 0.038 to 0.045 mg. intrathecally.

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PREFRONTAL LOBOTOMY FOR THE RELIEF OF INTRACTABLE PAIN

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THE operation of prefrontal lobotomy was first done by Moniz[1] for the relief of certain severe mental disorders in 1935. It was first started in this country by Freeman and Watts.[2] At that time the operation was a blind procedure done with a wire loop. In 1937 the operation was first done by the author using the open technic, severing the deep association pathways with a blunt dissector.[3] This enabled one to control the bleeding and to obtain a better visualization of the plane of section. Since then there has been no need to change this technic to any great extent.

Patients with severe mental suffering from various psychoses and other milder forms of nervous and mental disorders were relieved. Many of these had pain and it was a natural sequence for Freeman and Watts[4] to suggest that the procedure be used for the relief of severe intractable pain. Since then the procedure has been used by Poppen,[5] Dynes,[6] Scarff,[7] Williams[8] and many others.

We may divide pain and suffering into mental and physical types. In the former there is probably no organic basis for the complaint since it is in the psychic experience of the individual. In the latter there may have been an organic lesion which was eradicated but it has left a mental impression which has not been forgotten. These pain impulses have established a permanent record in the central nervous system of the individual. In some cases of organic pain, as in carcinoma, there may be little or no mental alteration at first, but sooner or later the psychic sphere of the individual will be altered by the constant bombardment of the painful stimuli, which leads to nervous tension, restlessness, apprehension, depression, drug addiction and sometimes to suicide. The higher centers for the psychic experience of pain are probably located in the frontal lobes. Since man is the only species with a fully developed frontal lobe, one would expect severe intractable pain to be limited to the human race. Although lower animals may have pain, it probably does not make a permanent and lasting impression because these animals do not show anxiety, tension and other evidence of severe suffering, probably due to the fact that they do not have a fully functioning frontal lobe as found in man.

The operation of prefrontal lobotomy severs the connecting pathways between the prefrontal lobe and the diencephalon. (Fig. 1.) The pathways are located chiefly in the inferior part of the frontal lobe. The procedure does not prevent the patient from feeling pain, the center of which is located in the thalamus. After a prefrontal lobotomy the patient may show an immediate increase of sensitivity to pain manifested by the painful reaction of pulling adhesive off the skin or from removal of the skin sutures after the operation. This is probably due to a lack of inhibition to a painful procedure very much like the resistance of a lower animal to the prick of a needle. Although the pain is felt, it does not last as a permanent experience. It is soon forgotten and the patient does not mention the fact that he has pain unless asked about it. No further request is made for drugs although many of these patients are drug addicts. It is an easy matter to stop all drugs in these cases but there may be withdrawal symptoms if they are stopped suddenly.

The operation cuts the inferior fibers of the frontal lobes. This alters the mood and affect of the individual. It does not interfere with the intelligence, judgment and reasoning of the patient since the superior quadrants of the lobes are disturbed very little. With this type of procedure very seldom does one see the involuntary urination or severe mental inertia seen when the more extensive operation is performed.

In order to obtain the best results the operation should be done on both sides. Scarff[7] reported ten cases of unilateral lobotomy for intractable pain, but the patients had been followed up only a few months when the report was made. Unilateral lobotomy was first done by the author in 1939 for the relief of certain

FIG. 1. Coronal section through right frontal lobe at place for dissection; the lines represent the triangular area where section of the association pathways is made. The other side shows a horizontal section through the middle of left cerebrum.

intractable mental disorders, and preliminary report was made[9] about that time. Unilateral lobotomy was done in a total of ten cases, many of which required a subsequent operation on the other side. It did not make any difference whether the operation was done on the lesser or the dominant side since the effect was essentially the same. Since the unilateral procedure is only about one-fourth as effective as the bilateral operation, the author has not done the former since 1942.

The technic of the operation is essentially the same as originally described.[3,9] (Fig. 2.) The scalp is marked for the proposed incision at a point 3 cm. lateral to the midline and about 4 cm. in front of a vertical line above the tragus of the ear or halfway between this line and the eyebrow. This makes the point of incision about the level of the hairline in most individuals. Using local anesthesia an incision is made 4 cm. long curving slightly to follow the hairline. In some individuals it is necessary to use a general anesthetic. The scalp and pericranium are retracted with a mastoid retractor which controls all bleeding. A 1-inch button of bone is removed with a trephine and saved for replacement in the wound when the closure is made. A curved

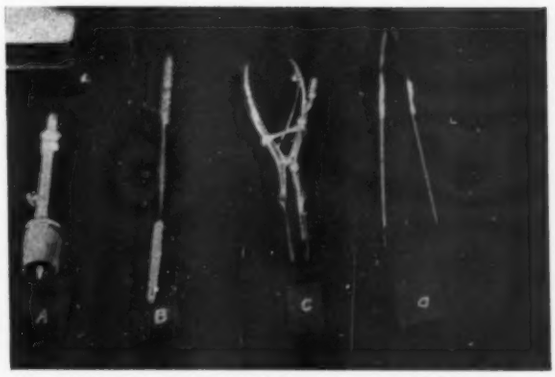

FIG. 2. Instruments used in prefrontal lobotomy. A, 1-inch trephine; B, Kerrason blunt dissector; C, lighted brain speculum; D, long Ballenger thumb forceps.

flap from the outer layer of the dura is cut and turned back. A similar flap is cut from the inner layer and turned in the opposite direction, the purpose being to make the dura close in an easier manner. A short stab incision is then made through an avascular area of the cortex, controlling any bleeding with a cottonoid pack. Care is taken not to coagulate any vessels on the brain surface. In doing this for the past six years the author has not had any convulsive seizures following the operation. A ventricle needle is inserted to the floor of the skull near the ridge of the lesser wing of the sphenoid or just in front of the anterior horn of the ventricle. Then the blunt dissector is inserted parallel with the ventricle needle to the floor of the skull. After withdrawal of the needle the dissector is swept across from the midline to the side as far as possible to cut the association pathways, at the same time avoiding the resistance of a blood vessel. If the latter is encountered, the dissector is withdrawn until it is free and the dissection is carried to the vessel on the opposite side. The plane of the section is in the form of a triangle with the base at the floor of the skull and the apex at the top. The wound is then packed with several finger-sized strips of cottonoid which are left a few minutes before they are removed. A final inspection is made using a special lighted brain speculum to visualize the area cut and to control any bleeding points by further packing or, in case of bleeding from a small artery, by the application of a silver clip. In closure of the wound the dural flaps are replaced, one overlapping the other. The trephine button of bone is replaced. In the case of a bald-headed individual a

tantalum plate is formed over the trephene opening, leaving the button of bone out of the wound. In this way no visible defect in the skull contour is seen through the thin bald scalp. The scalp wound is closed in the usual manner. The operation takes about one hour. The immediate postoperative progress will not be mentioned except in connection with the cases of prefrontal lobotomy herewith reported. There has been no mortality from the operation in over 120 cases of prefrontal lobotomy. There was one postoperative hemorrhage which required reoperation on the second day. After the bilateral clots were removed, the patient made a good recovery. Twelve cases of prefrontal lobotomy for the relief of intractable pain are reported as follows:

CASE REPORTS

CASE I. G. L. P., a sixty-three year old male, had a painful amputation stump, left upper extremity. This patient had had his left arm mangled just below the shoulder in an automobile accident requiring an amputation just below the shoulder joint in December, 1935. Since then he had had a severe drawing and burning sensation in the phantom extremity.

The neurologic examination was negative except for a restless, agitated, worried individual. He moved the stump of the amputated extremity constantly and any attempt at touching the skin of the stump caused a reaction of severe pain. The patient stated the left hand felt like it had been immersed in boiling oil. He had become addicted to drugs and was taking 3 gr. of morphine daily.

On October 4, 1947, a bilateral prefrontal lobotomy was performed. The operation was uneventful and nothing unusual was found. Because of the patient's bald head a tantalum plate was molded over each trephine opening for cosmetic reasons.

The wound healed primarily. The patient became greatly confused soon after the operation. He was so disturbed that he had to be sent to the State Hospital. This acute delirium soon subsided and he became quieter, cheerful and talked in a normal manner. He did not complain of the disturbance in the amputated extremity. Drugs were no longer required and he returned home to his family. The last report on February 22, 1949, showed continued great improvement.

CASE II. M. L. Y., a sixty-seven year old female, was admitted to the Florida State Hospital, October 11, 1946 with a diagnosis of painful amputation stump, left lower extremity. According to the history a wound had developed on the patient's left leg followed with severe infection and osteomyelitis. It led to amputation of this extremity at the thigh in December, 1944. Ever since the patient had had a severe burning, painful sensation in the phantom extremity. Associated with this she was agitated, restless and was constantly moving her stump. She was constantly asking for drugs and showing great mental suffering.

On October 23, 1947, a bilateral prefrontal lobotomy was performed. The operation was done under local anesthesia and conversation was carried on with the patient during the section through each frontal lobe. Immediately after section of the second frontal lobe the patient stated that pain in the phantom limb had disappeared.

The immediate postoperative progress and healing of the wound were uneventful. The patient was considered to be greatly improved in that she was quieter and did not show the restless, agitated state that she did previously. She did not complain of the pain in the phantom limb although she said that she had pain when she was asked. She was discharged from the hospital. From the last report, March, 1949, she was greatly improved.

CASE III. M. F. B., a forty-nine year old female, was admitted with a diagnosis of intractable pain, right intercostal neuralgia and vascular hypertension. This patient had had a bilateral splanchnic sympathectomy by someone else in September, 1943. It was followed with severe right intercostal neuralgia. Three posterior roots to the intercostal nerves had been resected at laminectomy without relief of the patient's pain. She continued to be restless, agitated, emotional and depressed and was crying during most of the conversation. The vascular hypertension had been only partially relieved by the sympathectomy. The patient was taking opiates regularly for relief of pain. On examination she was thin, emaciated, restless and suffering with severe pain. Her blood pressure was 230/130. The examination was otherwise negative except for the operative scars from the aforementioned operations.

On June 23, 1948, a bilateral prefrontal lobotomy was performed. After operation the pa-

tient was a changed person; her facial expression changed and she was happy and cheerful. She did not complain of pain or ask for medicine. One month later she came to my office by herself. Her blood pressure was 170/90. Since then she has continued to live in her home, doing her regular housework. She has gained weight and her blood pressure has remained at a slightly lower level than it had been previously.

Case IV. A. J. B., a fifty-two year old female, was admitted with a diagnosis of intractable pain due to carcinoma of the uterus and pelvis. The patient had been under treatment for carcinoma of the uterus for the past two years. The pain was located across the lower back in both hips, radiating down the right thigh to the knee, gradually getting worse. She was taking demerol regularly every three hours. The neurologic examination was negative except for an emaciated, worried depressed person suffering from acute pain.

On November 19, 1948, a bilateral prefrontal lobotomy was performed. Nothing unusual was found at operation. The right button of bone was dropped to the floor by an assistant. It was boiled and replaced.

The wound healed primarily. The patient showed very little impairment of memory and mental confusion for the first few days. She was cheerful, alert, and at no time showed involuntary urination or other disturbances during her hospital convalescence. She did not mention her old pain and no medicine was required for the relief of pain. She was discharged from the hospital eleven days postoperatively.

Case V. W. R., a forty-five year old female, was admitted with a diagnosis of severe intractable pain of the left side of the head and left upper extremity from cervical disc injury. The patient had been injured in an automobile accident in September, 1944, receiving injury to the left shoulder and neck. The diagnosis of a cervical dislocated disc had been made and the patient had been operated upon in another clinic in March, 1945. Following this operation severe pain in the left side of the head, neck and arm continued. Further history revealed that an effort had been made to relieve the pain by posterior root rhizotomy of the left upper five cervical nerves and by resection of the left supra-orbital, temporal and posterior auricular nerves. These procedures had been done elsewhere in July, 1947. All failed to relieve her of pain. In addition she was emotional, depressed, nervous, tense, cried and took drugs regularly in an effort to relieve the pain.

On examination there was complete anesthesia on the left side of the neck from the first to the fifth cervical root distribution, inclusive. There was hypalgesia in the left frontal and temporal regions of the head. Examination was otherwise negative except for slight reflex changes which would be attributed to the old cervical dislocated disc.

On January 18, 1949, a bilateral prefrontal lobotomy was performed. The operation was uneventful except a small artery on the right side near the cortex was severed and required three silver clips to control it.

After the operation the patient stated that she was completely relieved of the pain. The great emotional distress and mental depression were relieved. She was relaxed, cheerful, and showed little or no mental confusion. She did not require medication for relief of pain. There was no mention of pain on the left side of the head, neck or arm. The patient was discharged fifteen days following operation. A communication from her husband in May, 1949, showed satisfactory improvement. This patient was last seen on July 11, 1949. She was having some of the old pain but was cheerful and considerably improved. The lobotomy was probably too far anterior.

Case VI. L. E., a fifty-nine year old male, was admitted with a diagnosis of painful amputation stump, left leg, and severe intractable pain, right leg, due to peripheral vascular disease. This patient had had his left leg amputated above the knee in 1945 for peripheral vascular disease with arteriosclerosis. There was a history of intermittent claudication in both extremities before the operation. He continued to have pain due to vascular impairment in the right leg which required crushing of the posterior peroneal nerve in February, 1949. He had had a right lumbar sympathectomy in March, 1949. In spite of these procedures he continued to have severe intractable pain in the right lower extremity. He also complained of a severe burning, drawing, painful sensation in the left phantom extremity. The skin area over the stump of the left lower extremity was extremely sensitive and painful. The patient was emaciated, bedridden, restless and was constantly asking for medicine for relief of pain. His blood pressure was 210/120.

On January 26, 1949, a bilateral prefrontal lobotomy was performed under local anesthesia. The operation was uneventful.

Postoperatively the patient was relaxed and did not complain of pain in either lower extremity. He was quiet and did not ask for medicine. He was confused the first two weeks and sometimes refused to eat. His temperature was 102°F. the first day after the operation and then subsided. The blood pressure remained at a lower level but gradually came up to 180/90. He was discharged from the hospital three weeks after operation. Since then this patient has been coming to the outpatient department regularly and is greatly improved. There is no request for drugs and no complaint of pain unless asked about it.

CASE VII. J. H., a sixty-five year old female, was admitted with a diagnosis of severe intractable pain due to carcinoma of the cervix and pelvic bones. This patient had had carcinoma of the cervix and uterus five years before, treated with hysterectomy. This was followed with numerous x-ray and radium treatments but there was recurrence with metastases to the pelvic bones. She had had severe intractable pain in the back and both legs since November, 1947, and required opiates regularly. There was great emotional distress, nervousness, apprehension and mental confusion.

On February 21, 1949, a bilateral prefrontal lobotomy was performed. The operation was uneventful. Postoperatively the patient was mentally confused. She required artificial feeding. Her general condition was weak. She did not ask for drugs. The mental state gradually improved and she became cheerful and alert. She was somewhat euphoric. She was able to get out of bed on her discharge from the hospital one month later. Since the operation she has been at home with her family; this had been impossible for a long time. Opiates are not required. She has greatly improved.

CASE VIII. B. H., a forty-four year old male, was admitted with a diagnosis of severe bilateral tinnitus, deafness and post-traumatic headaches. This patient had been injured thirteen years previously in an automobile accident, which resulted in deafness and tinnitus in the right ear and a complete peripheral type of facial paralysis on the right followed with headaches. For the past six months the patient had been nervous, depressed and apprehensive. Severe intractable bilateral headaches, tinnitus and partial deafness developed in both ears.

The examination was negative except for complete right facial paralysis. There was total deafness in the right ear and partial deafness in the left ear.

On February 24, 1949, a bilateral prefrontal lobotomy was performed. Postoperatively the patient awoke from the anesthetic with a changed facial expression. At no time during his stay in the hospital did he complain of his old symptoms. He stated that the tinnitus in the left ear had entirely disappeared and that he still had a little in the right ear but it did not bother him. He made no complaint of headache. The slight mental confusion disappeared after the first week. There was no involuntary urination at any time. He was discharged two weeks after the operation.

On the last examination about May 1, 1949, the patient was greatly improved. He stated he had a little ringing in the right ear but he made no complaint about it. He had gained weight and was beginning to do light work, which he had not been able to do for about a year before the operation.

CASE IX. H. D., a thirty-six year old male, was admitted with a diagnosis of severe intractable pain due to carcinoma of the colon with metastases to the bladder and pelvis. The patient had had carcinoma of the colon in August, 1946, requiring resection with colostomy. There had been recurrence with metastases to the bladder and pelvic bones and severe intractable pain in both hips and legs, especially in the region of the bladder and rectum. He was taking ½ gr. of morphine every two hours or a total of 12 gr. daily in an attempt to relieve the pain.

On March 1, 1949, a bilateral prefrontal lobotomy was performed. The operation was uneventful. Postoperatively there was no impairment of memory. The patient's mood was elevated. He was cheerful and his outlook on life was greatly improved. The morphine was gradually reduced and was stopped entirely ten days after the operation. The patient had no complaint of pain. There was moderate swelling in both legs, especially the right. It was not known whether this was the effect of the operation or due to the pathologic condition in the pelvis. He was discharged fourteen days after

the operation. His condition continued greatly improved.

CASE X. L. M., a fifty-one year old female, was admitted with a diagnosis of atypical facial neuralgia and psychoneurosis. The patient had been nervous and melancholic all her life. She had had pains about her face and head most of her life. Eight years before the patient went to a dentist because of severe pain in the upper jaw. He extracted teeth and incised the gums without relief. The pain extended to the temporal region and the patient was treated extensively for temporomandibular joint neuralgia by various operations and with numerous fittings of dental plates and bridges without relief. She had recently had a series of electric shock treatments.

On October 1, 1948, a bilateral prefrontal lobotomy was performed. The operation was uneventful. The immediate postoperative progress was good. There was little or no mental confusion. She was discharged from the hospital thirteen days following operation. At no time did she complain of pain in her face or jaw, or have any other complaints. She was alert and cheerful. She has been seen several times since then and has continued to be well. She does her housework and continues her social activities on the outside.

CASE XI. S. P., a fifty-three year old female, was admitted with a diagnosis of left facial neuralgia, atypical, depression and postherpetic intercostal neuralgia. For the past few years she had had pain about the head and left face following extraction of teeth. She had had bridge work and plates without relief of symptoms. In April, 1948, herpes zoster developed on the left chest followed with intercostal neuralgia. She had had severe post-herpetic neuralgia off and on since then. The patient had recently been given twelve electric shock treatments, with only partial relief.

On examination the patient was fairly well nourished and in good physical condition.

On April 22, 1949, a bilateral prefrontal lobotomy was performed. Nothing unusual was found at operation. The patient made a good operative recovery. There was no confusion at any time. She was bright, alert and cheerful. She never mentioned her facial or chest pain. She was sitting up, walking and was discharged from the hospital fourteen days postoperatively.

CASE XII. E. M. M., a forty-eight year old female, was admitted with a diagnosis of painful spasmodic torticollis. This patient had had painful spasmodic torticollis for fourteen years. The muscles on both sides of her neck were involved. There was tonic spasm of muscles with intermittent jerking of head. In 1939 a cervical laminectomy had been done with section of the right upper three anterior roots and the upper two on the left side, at the same time cutting both spinal accessory nerves. Following the operation the patient was improved. Lately there had been some recurrence with intermittent jerking of the head. She had also become depressed and very nervous. Examination revealed a nervous, crying, rather thin female. There were tonic spasms of the muscles of both sides of the neck, turning the chin to the left. Occasionally there would be jerking of the head.

On March 26, 1949, a bilateral prefrontal lobotomy was performed. The postoperative recovery was uneventful. She was discharged from the hospital fourteen days following operation. There was slight confusion the first few days. The nervous tension and mental depression were gone. She was cheerful. She did not mention her old pain. There was less spasm of the muscles of the neck.

CONCLUSION

Twelve cases of intractable pain are reported which were relieved by bilateral prefrontal lobotomy. They include three cases of painful amputation stump, three cases of carcinoma of the pelvic region, two cases of atypical facial neuralgia and one each of severe intercostal neuralgia, pain of head, neck and arm following cervical disc removal, and post-traumatic headaches and tinnitus. The bilateral prefrontal lobotomy was done in every case because the unilateral operation too frequently has been ineffective in relieving patients with mental disorders. The operation does not abolish physical pain but tends to change the mental attitude so that the patient does not suffer as he did before. In like manner, the mood is elevated and there is a lessening of nervous tension, anxiety and fear of the future. It is an easy matter to withdraw opiates even though drug addiction was a major factor in the illness.

Prefrontal lobotomy should not replace cordotomy and other surgical measures for the

relief of pain in all cases. The patient and the family should help in making the decision as to the procedure of choice.

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Pedunculated hydatids of Morgagni, when found during the course of a laparotomy, should be excised if this can be easily done so that they may not undergo torsion at some later date. One midwestern gynecologic center recently reported five cases in which torsion occurred and caused fever, colicky pains, acute distress, nausea and other symptoms often simulating appendicitis. (*Richard A. Leonardo, M.D.*)

SURGICAL TREATMENT OF EXTRACEREBRAL HEMATOMA IN ACUTE CRANIOCEREBRAL INJURY*

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THE neurosurgical service of any large receiving hospital is confronted with many severe craniocerebral injuries. Frequently it is difficult to decide when to subject these patients to surgical intervention. Voris[10] previously outlined the indications for operative treatment of head injuries as follows: (1) compound depressed skull fracture; (2) certain simple depressed skull fractures and (3) extracerebral hematomas. This paper is concerned with those patients who have been treated because of extracerebral hematomas. All compound depressed fractures of the skull and simple depressed fractures have been eliminated from this paper because the indications for surgery in these cases are usually clear-cut. Our policy is to perform thorough débridement of the skull and brain with closure of the scalp in all compound injuries as soon as the patient's condition permits.

In our experience many patients with craniocerebral injuries are admitted *in extremis;* many are comatose, intoxicated, unidentified or unable to supply adequate history. Some of these severely injured patients present localizing and lateralizing signs. The problem is to decide just which of these critically ill, comatose individuals should be submitted to surgery. The mortality rate of those subjected to burr hole exploration has been high; frequently these explorations have been done when the patient was *in extremis* because it was believed that there was a strong likelihood of extradural clot. Because of the high mortality associated with this procedure, all of the patients upon whom emergency exploration was done for closed craniocerebral injury on the neurosurgical service at the Cook County Hospital during the fifteen-month period beginning January, 1948, and ending March, 1949 are reviewed.

The syndromes of acute epidural hematoma and chronic subdural hematoma have been considered at length in the literature. However, this paper is concerned with the severe, acute, overwhelming craniocerebral injury. Kennedy and Wortis[7] reviewed seventy-two cases of acute subdural hematoma diagnosed at surgery or at autopsy and found a mortality rate of 77.7 per cent in the cases diagnosed at surgery not later than twenty-one days after injury. They stated that epidural hematoma complicates 2 to 5 per cent of all craniocerebral hemorrhages and that over a six-year period only seventeen cases of epidural hematoma were seen at the Bellevue Hospital. Vance[9] in a review of 512 necropsies when death followed head injury found 132 deaths caused by subdural hemorrhage and twenty-four by laceration of the brain. In sixty-one cases an extradural clot of significant size was observed. Gurdjian[2] presented eleven operative cases of acute subdural hemorrhage with death following in five; he did not state how much time elapsed from injury to time of operation nor the condition of the patients when surgery was performed. In a later paper[3] the same author presented thirty-nine operative cases of acute subdural hematoma which resulted in fifteen deaths. Wortis and Kennedy[14] studied 1,000 cases of head injury and reported a mortality of 37.8 per cent; 20.1 per cent of the fatalities occurred in the first twenty-four hours, and the authors believe that this argues for early conservative care. They eliminated all operative cases of subdural hematoma from their series. Hawkes,[5] Courville[1] and Jefferson[6] have noted the high mortality occurring early in acute craniocerebral injury. Raaf[8] discussed seven cases of acute subdural hematoma in which the patients were operated upon within six weeks of the time of injury with two deaths; eleven patients were also explored, without finding a hematoma, death occurring in four cases. Voris[10–13] has emphasized that acute subdural hematoma is a relatively massive acute hemorrhage usually associated with severe cerebral injury, either contusion or laceration, and has presented twenty-three cases subjected to sur-

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gery within one week of injury with death following in nineteen.

During the fifteen-month period from January, 1948, to March, 1949, fifty-six individuals were subjected to exploration because of head trauma. Thirty-one of these patients were operated upon within three days of the time of injury, eight within three to seven days and seventeen did not have exploration performed until a week or more had elapsed from the time of injury. We are primarily interested here in the first group of thirty-one cases but will mention the other cases treated during this fifteen-month period so that a basis of comparison will exist. (Table I.) The mortality rate of those treated within one week after injury was found to be 75 per cent while those treated surgically after a week or more had elapsed from the date of injury showed a mortality of 35 per cent. This last group is made up of two distinct types of cases: those showing signs of severe head injury from the beginning as manifested by coma or stupor from the onset and those whose symptoms developed gradually after a prolonged, more or less symptom-free interval following injury. In thirteen instances of prolonged lucid interval only one postoperative death followed and that did not occur until six weeks after the time of surgery. Four other individuals making up this group of seventeen cases died shortly after surgery, all having had a history of coma or stupor since the time of injury. Those individuals with slowly developing symptoms of increasing intracranial pressure were all found to have well encapsulated subdural hematomas at the time of surgery, with a single exception in which a chronic extradural hematoma was discovered. These cases with gradual onset of symptoms and physical findings presented no problem in either diagnosis or treatment.

TABLE I

Time of Treatment after Injury (days)	No. of Patients	Mortality		Psychosis	Recovery
		No.	Per cent		
1 to 3	31	23	74.2	2	6
3 to 7	8	6	75	0	2
After 7	17	6	35	0	11

Table II contains findings at the time of surgery. It can be seen that the accuracy of diagnosis is increased when the patient's symptoms are permitted to develop over a period of time; unfortunately, such a delay is not always possible if an extradural hematoma exists. In the eight cases explored from three to seven days after injury four showed no evidence of hematoma. Our policy is to institute immediate surgical therapy when lateralizing signs and a decrease in sensorium or response to painful stimuli become evident. This group of eight cases seems to represent the cases of more doubtful diagnosis in which delay seemed advisable; even so, no hematomas were found in 50 per cent. In the group of thirty-one patients operated upon within three days of the time of injury, only five did not have a hematoma. All sixteen patients treated seven days after injury had a hematoma present at the time of surgery.

TABLE II
FINDINGS AT THE TIME OF SURGERY

Time of Treatment after Injury (days)	No. of Cases	Subdural Hematoma	Epidural Hematoma	No Hematoma
1 to 3	31	23	3	5
3 to 7	8	4	0	4
After 7	17	16	1	0

TABLE III
MORTALITY RATE IN THIRTY-ONE CASES OPERATED UPON WITHIN THREE DAYS OF THE TIME OF INJURY

Condition Found and No. of Cases	Recovered	Mortality	
		No.	Per cent
Subdural hematoma—(23)	5	18	78
Epidural hematoma—(3)	2	1	33
No hematoma—(5)	1	4	80

Of the thirty-one patients who were treated by surgical exploration within three days of injury, thirteen were taken to the operating room as soon as preparations could be made; the remainder were observed for varying periods up to three days. (Table III.) Twenty-six of the thirty-one patients showed signs of hemiparesis; in seventeen pathologic reflexes were elicited; twenty-one patients showed a dilated, fixed

pupil and in two both pupils were dilated and fixed. The male sex predominated (twenty-nine cases) and at least thirteen were chronic alcoholics. Signs of either laceration or bruise of the face or scalp were seen in twenty-four cases. All depressed fractures, compound injuries of the brain and gunshot wounds of the head are eliminated from this series as previously stated.

Diagnostic lumbar puncture was done in nineteen cases; sixteen showed bloody spinal fluid and three xanthochromia. The spinal fluid pressure was normal in two and elevated in seventeen.

The average age in this group was 44.6 years; the youngest patient was twenty-two years and the oldest, eighty-five. Twenty-six patients showed lateralizing signs other than pupillary changes and seventeen presented pathologic reflexes. Twenty-nine patients were judged to be in coma and two in stupor.

Any surgical procedure with a postoperative mortality of almost 75 per cent should be critically analyzed. In our experience it has been impossible to make the diagnosis of epidural hematoma without resorting to surgical exploration. Acute subdural hematoma is not always a surgical condition because it is almost invariably associated with extensive laceration of the brain. It is not the expanding hematoma which brings about the patient's death but the underlying damage to the brain substance which usually occurs in the frontoparietal region because of the anatomy of the skull in this area. The purpose of the exploratory burr hole is not necessarily to release a subdural hematoma but to make a positive diagnosis of epidural hematoma which is a condition highly responsive to early surgical intervention. In this series of thirty-one cases three patients were found to have isolated epidural hemorrhage, with two recoveries. In twenty-three instances large, subdural collections of hematomas were evacuated; and in five cases no hematoma was found although the brain showed evidence of contusion and edema. One of the patients in whom an epidural hematoma was evacuated gave a history of a brief lucid interval but no such history was obtained in the other cases.

We have not hesitated to take aged, debilitated individuals to the operating room when the progression of physical findings indicated a strong possibility of an expanding clot as we thought that death was inevitable in many patients unless an epidural hematoma could be found responsible and evacuated. Raaf[8] states that "I have made it a rule never to let a patient expire without trephining the skull unless he has a head injury of such severity that his case is obviously hopeless." This has also been our custom since we have seen epidural hematomas without underlying brain damage at autopsy that had not been given the benefit of surgical exploration because of the possibility of a fatality.

The most important criteria for diagnosis are a decrease in the state of consciousness associated with neurologic findings of a lateralizing nature, such as diminished or absent reflexes on one side, complete hemiplegia or a dilated fixed pupil. Spinal puncture with the finding of an elevated spinal fluid pressure and blood-tinged fluid are helpful in the diagnosis. Ordinarily a more accurate evaluation is possible if there is a changing neurologic picture that can be followed but many patients are brought to us with far advanced signs of a lateralizing nature and in deep coma. Since a history is not always available, it may be impossible to know if the symptoms have been progressive and if the state of consciousness has deteriorated into coma.

Thirteen of our cases were known alcoholics and in all probability a larger number would have been proven similarly affected if a history was available. Others[4] have postulated the predisposition in alcoholics for epidural and subdural hematoma on the basis of increased fragility of the vessels.

Our procedure at the time of surgery is an anterior parietal burr hole so that the bleeding from the middle meningeal artery, if present, may be easily controlled by enlargement of the opening and exposure of the bleeding point. We have made it a policy always to open the dura bilaterally, and in this group of thirty-one cases clots were found on both sides in six instances. It is not necessary to make multiple burr perforations nor to turn a flap of bone. Any hematoma that we have encountered has been evacuated through the enlarged burr hole by the use of a brain spoon and warm saline irrigations through a soft rubber catheter. A rubber tissue drain is important because in these acute cases more blood will collect at the site of the evacuated hematoma. Infiltration of the scalp at the site of incision with 1 per cent procaine

is a satisfactory anesthetic in these stuperous or comatose patients. In restless and uncooperative patients supplementary intravenous sodium pentothal may be necessary.

Nine of the twenty-three patients who died following surgery were subjected to autopsy by the coroner's pathologist. Eight were found to have skull fractures, seven showed laceration of the brain and subdural collections of blood and one case showed purulent meningitis over an area of brain laceration.

CASE REPORTS

CASE I. T. K., a thirty-nine year old white woman, was admitted to the Cook County Hospital on February 23, 1949. No history could be obtained from the patient but the husband stated that she had been drinking heavily for the past few months and shortly before admission had struck her head against the kitchen sink while in a drunken stupor. At the time of admission the temperature was 98°F., respiration 22, pulse rate 96 and the blood pressure 150/90. The left pupil was slightly larger than the right but both reacted to light. Deep reflexes were normal and there was no Babinski sign. Six hours later the patient responded only to painful stimuli. The temperature was then 105°F., the blood pressure 170/90 and the pulse 100. The pupils were small, fixed and equal. There was a flaccid paralysis of the left arm and leg with bilateral Babinski signs. Spinal puncture showed bloody fluid under a pressure of 230 mm. of spinal fluid. Eleven hours after admission bilateral anterior parietal burr hole exploration was carried out and a large subdural clot evacuated on the left. The patient expired forty-eight hours later; autopsy showed a laceration of the anterior parietal lobe with subdural hemorrhage over both parietotemporal lobes.

CASE II. M. A., a fifty year old colored man, was admitted to the neurosurgical service on March 14, 1949, with a history of having been found comatose in a hallway with his pockets turned out. The blood pressure was 170/70, the pulse 70 and respiration 20 per minute. There was discoloration about the eyes, the neck was rigid and the pupils normal. Deep reflexes could not be elicited in the lower extremities, but there was a right Babinski sign. On the following day the patient responded to painful stimuli but was confused and lethargic. The next day the patient showed little response to painful stimuli and a spinal tap showed blood-tinged fluid under a pressure of 220 mm. of spinal fluid. Bilateral anterior parietal burr-hole exploration was done immediately and a 50 cc. subdural clot evacuated on the right. The patient improved rapidly and was discharged on the fourteenth hospital day still confused about past events.

CASE III. J. H., a young, colored man, was admitted to Cook County Hospital on February 19, 1949, at 3:30 A.M. with a history of having been struck by a car. He was in profound coma and his breath smelled of alcohol. The right side of the face was bruised and there was a laceration of the upper lip. The patient moved the left arm and leg but not the right. The blood pressure was 122/80, the pulse rate 60, respiration 28 and temperature 98.6°F. The right pupil was dilated and fixed; superficial reflexes were absent and deep reflexes markedly diminished on the left. Spinal tap showed Burgundy-colored fluid under a pressure of 340 mm. of spinal fluid. At 7:00 A.M. that morning the patient's condition remained the same. The pulse rate was then 60, the blood pressure 130/80. Two hours later bilateral biparietal burr hole exploration was done without finding a clot. The subarachnoid space contained blood-stained spinal fluid and the brain appeared dusky and bulging. The patient continued in coma and began to show a high fever up to 105°F. at the time of death thirty-six hours after admission.

CASE IV. P. K., a forty-four year old white man, was admitted to Cook County Hospital on February 4, 1949, with a history of having been beaten by two unknown men. All reflexes were normal, the pupils were normal and the patient moved all extremities but was semi-comatose. There was a small laceration of the scalp. The next morning the physical examination had not changed. The pupils were normal and the patient thrashed about in bed so that examination was difficult. On the morning of the third hospital day it was noticed that the patient had a left hemiplegia. A spinal tap was done and bloody fluid under a pressure of 210 mm. of spinal fluid was obtained. Immediate bilateral exploration was carried out and a large (120 cc.) extradural clot evacuated on the right and a bleeding point in the middle meningeal artery controlled. Recovery was slow and the patient was transferred to another hospital on the 167th hospital day with a residual hemiparesis.

SUMMARY

1. Fifty-six individuals with severe head injury treated with emergency surgical exploration during a fifteen-month period at the Cook County Hospital are presented.

2. Thirty-one of these individuals were subjected to surgery within three days or less of the time of injury; this group is discussed in detail and compared with the group operated upon more than three days after the time of injury. Four cases are reported in some detail.

3. The term "acute subdural hematoma" should be reserved for those cases with signs of severe craniocerebral injury from the onset. These cases should be distinguished from those with slowly developing signs of increased intracranial pressure and alteration of cerebral function following injury.

CONCLUSION

The surgical treatment of acute subdural hematoma is not always satisfactory because the primary pathologic condition is not in the hematoma which can be evacuated but in the underlying damage to the brain substance. The chief reason for surgical exploration is to rule out the possibility of acute epidural hematoma, which is a condition highly responsive to early surgical therapy. The surgeon should not hesitate to subject the patient to exploration if the progression of the neurologic findings and a decrease in the state of consciousness suggest expanding hematoma. The associated mortality rate is high, but the eventual mortality rate when extensive brain laceration is present is not greatly increased by surgical intervention. An occasional patient with acute subdural hematoma is benefited greatly by evacuation of the clot.

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CONGENITAL MALFORMATIONS OF THE RECTUM AND ANUS*

WITH SPECIAL REFERENCE TO THE TREATMENT OF ASSOCIATED FISTULAS

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CONGENITAL malformations of the rectum and anus comprise an important group of anomalies in infancy. These anomalies may involve the rectum, anus, urogenital organs or combinations of these structures. Statistics of the frequency of these conditions are very variable; reports of the incidence[5,8,10,17] have ranged from 1:729 to 1:7,920 hospital admissions.

Embryology and Pathogenesis. In order to understand the pathogenesis of congenital malformations of the rectum and anus and their associated anomalies a knowledge of the normal embryologic development of the region is necessary. Excellent discussions of the subject have been contributed by Lewis,[19] Arey,[1] and Ladd and Gross.[16,17]

In the five-week embryo the urogenital sinus and the hindgut empty into a common cavity called the cloaca which is separated from the exterior of the body by the cloacal membrane. By the downgrowth of a mesodermic fold, the urorectal septum, a process of separation of the urogenital tract from the rectum is normally completed by the seventh week. For a time there is a small opening between the rectum and the urogenital tract which is known as the cloacal duct. The urorectal septum also divides the cloacal membrane into the urogenital membrane anteriorly and the anal membrane posteriorly, and these acquire external openings. A small invagination, the proctodeum, develops in the region of the future anus and the proctodeum and the rectum join their lumens by rupture of the anal membrane during the eighth week.

The rectal and anal anomalies and their associated malformations are interpreted as arrests in development in the seventh or eighth week of fetal life. An incomplete rupture of the anal membrane results in congenital anal stenosis. A rectal stenosis arises from incomplete development of the rectum. Persistence of the anal membrane results in membranous imperforate anus. The most common malformation is that in which the rectum ends blindly at some distance above the imperforate anus. The pathogenesis of this anomaly is not clear, but it is thought to be secondary to a deficiency in the lower posterior part of the cloaca.

Fistulas between the rectum and the genitourinary tract are established if the urorectal septum did not completely separate the rectum from the urogenital sinus, with persistence of the cloacal duct. A rectoperineal fistula forms if the anterior portion of the cloacal duct is closed and the posterior portion remains open. In the female, fistulas between the rectum and the vagina occur because as the müllerian ducts descend along the posterior wall of the urogenital sinus they encounter and acquire any existing fistula.

The external anal sphincter muscle develops from mesodermal components, the anus and rectum being of ectodermal and entodermal origin, respectively, and is usually developed in all types of these malformations.

Classification. The most useful classification of congenital malformations of the rectum and anus has been suggested by Ladd and Gross.[16,17] Four types are described as follows: type I, a stenosis at the anus or at a point several centimeters above the anus; type II, an imperforate anus, the obstruction being membranous in character; type III, (the most common) an imperforate anus, the rectal pouch ending blindly some distance above the anus; type IV, a normal anus and anal pouch, the rectal pouch ending blindly in the hollow of the sacrum.

Many infants with congenital anomalies of the rectum and anus have fistulous communications between the rectum and the genitourinary organs or the perineum. (Fig. 1.) The pathogenesis of these fistulas has been described in

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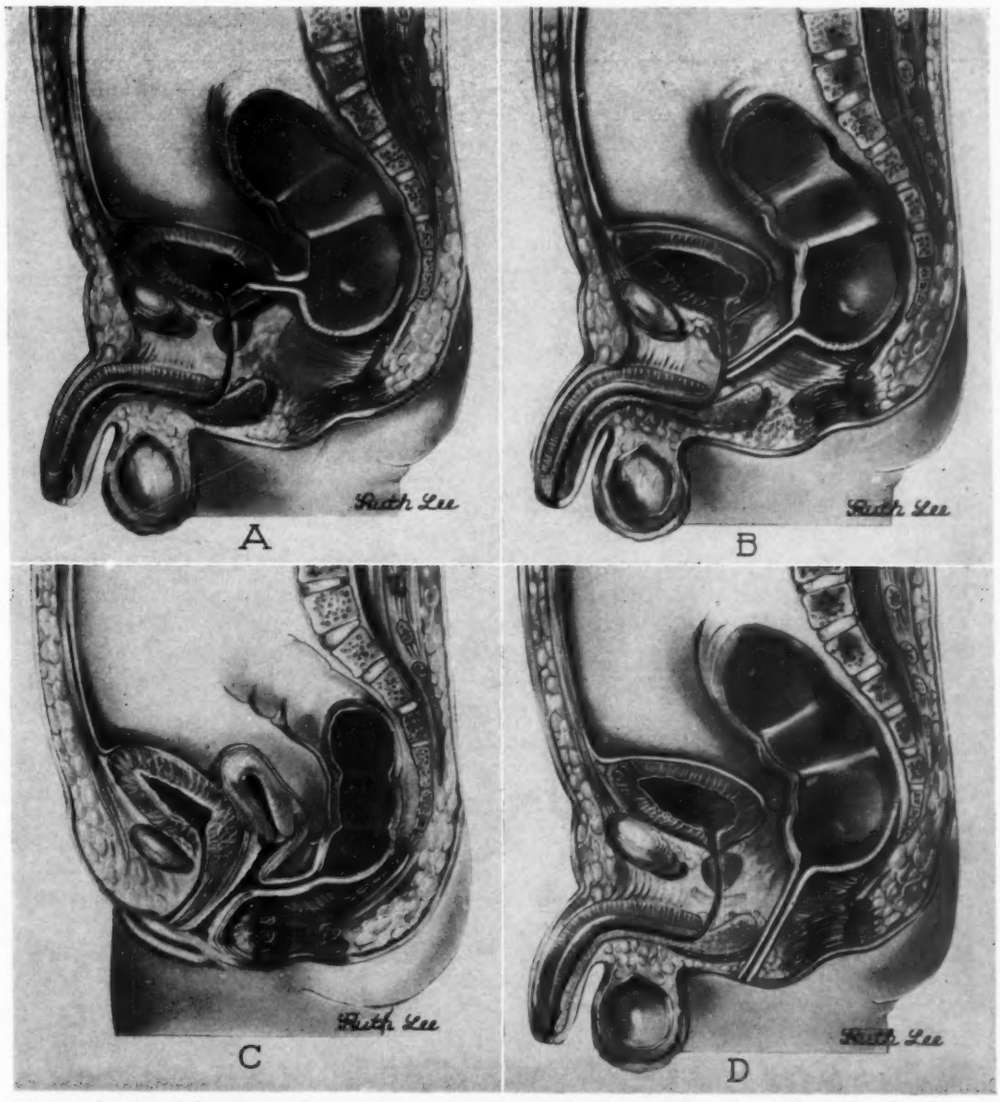


FIG. 1. Sectional drawings of type III anorectal anomaly showing locations of various fistulas. A, rectovesical; B, rectourethral; C, rectovaginal; D, rectoperineal. (Redrawn from LADD and GROSS. Abdominal Surgery of Infancy and Childhood. Philadelphia, 1941. Courtesy W. B. Saunders Co.)

the embryologic review. In males these may be rectovesical, rectourethral or rectoperineal fistulas, whereas in females these may be rectovesical, the more frequent rectovaginal (or rectofossa navicularis) or rectoperineal fistulas. The incidence of these complicating fistulas has been reported by the following authors: Ladd and Gross,[17] 118 fistulas in 214 cases (55 per cent); Bacon and Hering,[4] thirty-three fistulas in ninety-eight cases (33 per cent); Norris, Brophy and Brayton,[20] twenty-nine fistulas in fifty-two cases (56 per cent); Fichet,[12] nine fistulas in thirty-one cases (29 per cent); Starlinger and Richter,[25] fifteen fistulas in thirty cases (50 per cent); Crowell and Dulin,[8] seventeen fistulas in twenty-eight cases (61 per cent); Harken,[14] seven fistulas in twenty-five cases (28 per cent); Berman,[5] fourteen fistulas in twenty-three cases (61 per cent); Rosenblatt and May,[24] eight fistulas in twenty cases (40 per cent); Lee,[18] eleven fistulas in sixteen cases (68 per cent); Dmytryk,[10] five fistulas in fifteen cases (33 per cent). These fistulas occurred most frequently in patients with type III anomaly.

All patients in this series of eighteen cases had a type III malformation. A fistula was present in eleven of these cases, an incidence

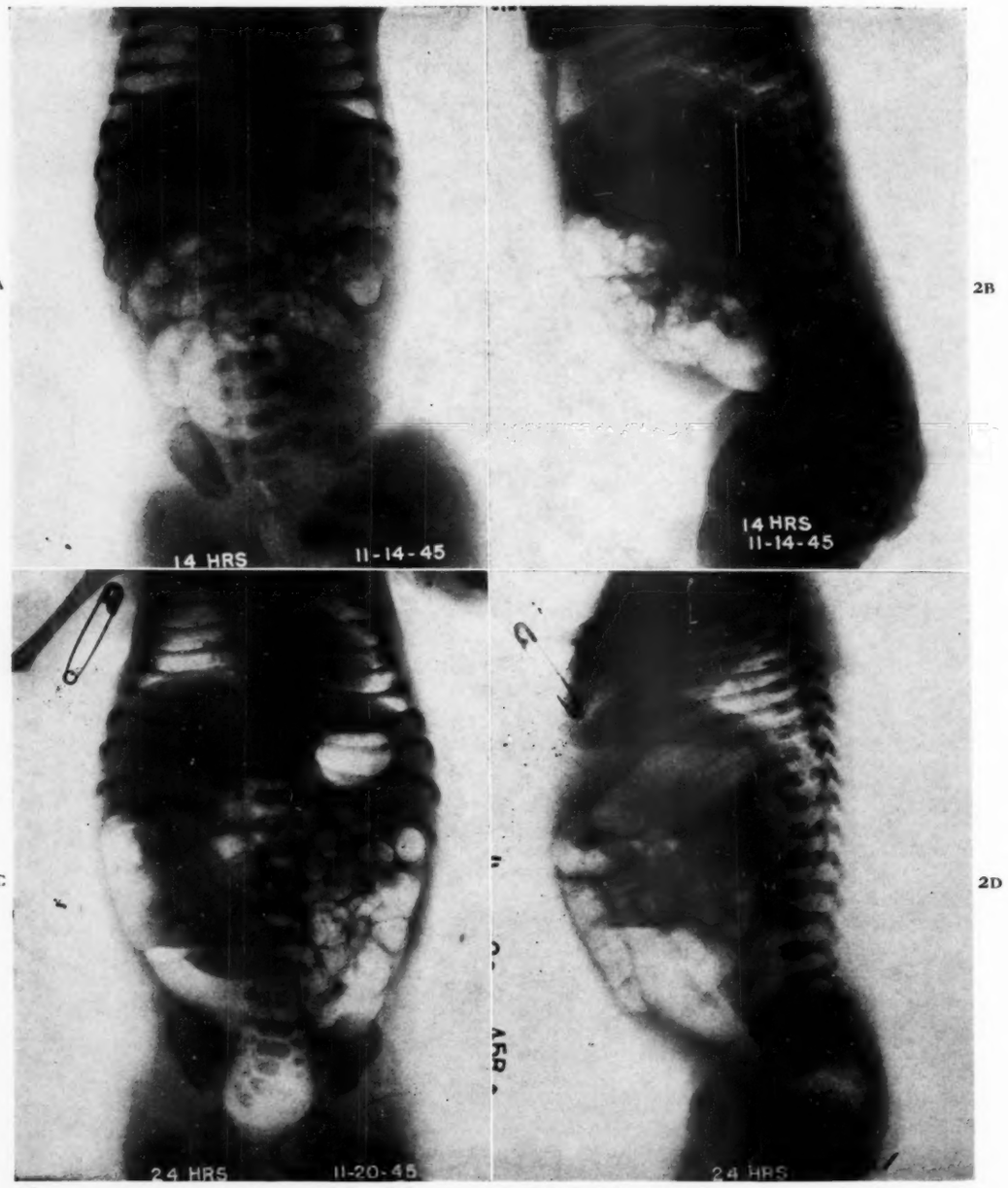
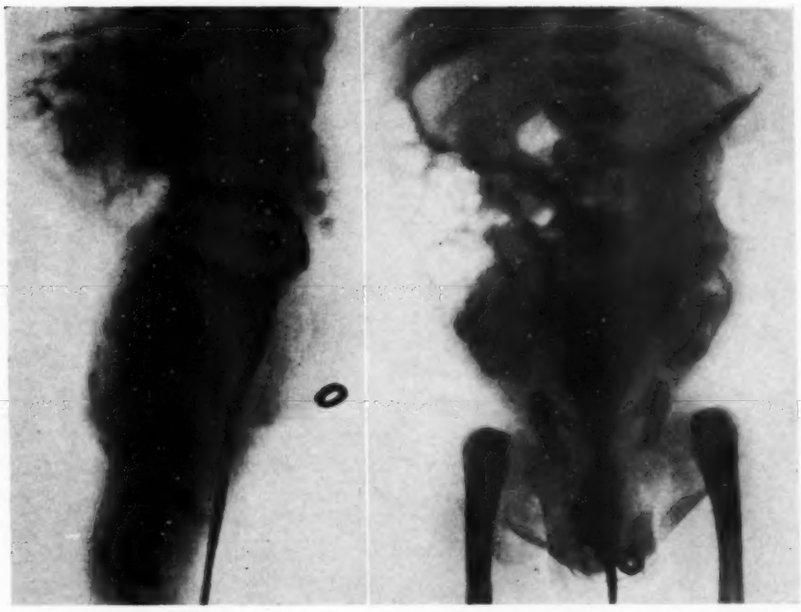


FIG. 2. A to D, roentgenograms of the abdomen and pelvis in infants with type III anorectal anomaly at the age of fourteen hours and twenty-four hours, using the Wangensteen and Rice technic. A and B visualize loops of dilated intestine in the abdomen; air has not entered the rectosigmoid. C and D show the gastrointestinal tract filled with air; the rectal pouch is clearly visualized in the pelvis.

of 61 per cent. The types of fistulas were as follows: rectovaginal, five; rectoperineal, three; rectovesical, two; rectourethral, one.

Associated Anomalies. Other congenital anomalies may be present, most commonly cardiac, urinary or intestinal, and this anomaly may be the cause of death. The incidence of additional malformations ranged from 28 to 68 per cent in various reports.[5,8,10,17,18,20] A serious additional anomaly is atresia of the esophagus. In the larger series of Ladd and Gross,[17] and Norris, Brophy and Brayton[20] this association was found in 2 per cent and 6 per cent of the cases, respectively, and there have been other single case reports.[13,21]

There were three patients in this series (16.6 per cent) who had additional congenital malformations. These were atresia of the duode-



3A 3B

FIG. 3. A and B, roentgenograms of the abdomen and pelvis showing lipiodol injected into a rectoperineal fistula visualizing the fistula and the rectal pouch; the marker indicates the site of the imperforate anus.

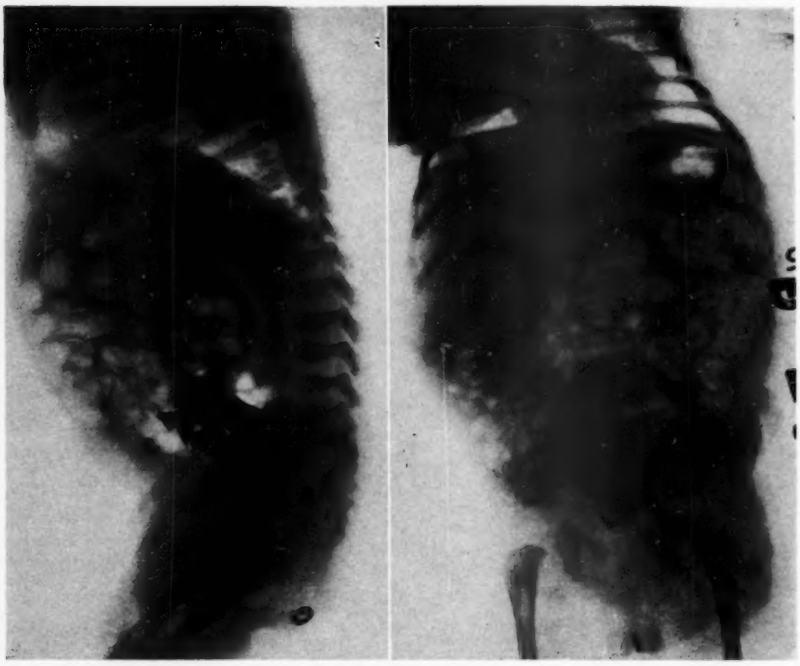
num in one case, atresia of the esophagus and duodenum in one case (previously reported by the author[2]) and atresia of the ileocecal valve and colon and agenesis of the colon in one case.

Clinical Features. These malformations are usually noted in the newborn period because meconium has not been passed or meconium has come through an abnormal opening such as the urethra, vagina or perineum. There may or may not be clinical evidence of intestinal obstruction, depending upon the duration of the obstruction (rarely manifest before forty-eight hours) and the presence or absence of an associated fistula.

The diagnosis of the type of malformation can be made by examination of the anal and urogenital regions. Type I is manifested by an anal or low rectal stenosis. A dark discoloration of an imperforate anus is noted in type II malformations. The anus is absent in type III anomalies, and a ridge or dimple with occasional puckering of the skin in this region is frequently seen. The opening of a rectoperineal or low rectovaginal fistula is evident, but a rectourethral, rectovesical or high rectovaginal fistula will not be seen. Rectourinary fistulas will often show a mixture of meconium and urine, but inspissated meconium may not come through a narrow fistula. Type IV malformation is revealed by an obstruction in the ampulla of the rectum.

Roentgen Examination. The accurate determination of the position of the rectal pouch has been aided by the technic of roentgenologic examination devised by Wangensteen and Rice.[26] This consists of x-ray examination of the abdomen and pelvis with the infant suspended in the head down position and a radiopaque marker at the site of the imperforate anus. The air in the colon will rise to the top of the rectal pouch thereby revealing its proximity to the perineal skin. Roentgenograms in the lateral and anteroposterior projections are taken. Wilson[28] advised that the roentgen examination be made after the infant has been suspended for at least five and preferably ten minutes. Rhodes[23] obtained more accurate films with the baby on its side and the knees held firmly flexed against the abdomen.

Ladd and Gross[17] noted inaccuracies in the films of two infants taken in the first twenty-four hours of life because air had not reached the rectum. Norris, Brophy and Brayton[20] had similar experiences in three cases. Therefore, reliance cannot be placed or roentgen examination before twenty-four hours; and if the infant's condition is satisfactory, films during the second day will be more accurate. (Fig. 2.)



4A 4B

FIG. 4. A and B, roentgenograms of the abdomen and pelvis showing lipiodol injected into the distal loop of the sigmoidostomy visualizing the rectal pouch ending in the pelvis a great distance from the site of the imperforate anus indicated by the marker.

Another source of error in the interpretation of the x-rays is the presence of a large amount of viscid meconium through which the air cannot penetrate even when films are taken during the second day. This error was noted by the author in films of a patient taken at the age of thirty-three hours showing the end of the rectum above the brim of the pelvis, whereas operation revealed a distance of 1 cm. between the rectal pouch and the perianal skin. Wilkinson[27] and Ehrenpreiss[11] have reported similar experiences. Since the advent of an abdominoperineal operation for occasional type III anomalies (Rhoads, Pipes and Randall[22] and Norris, Brophy and Brayton[20]) the latter authors believed that preoperative roentgenograms may frequently be omitted in cases of infants seen at an early age if this procedure is to be employed.

Roentgen examinations are also useful when there is an external fistula. The injection of a radiopaque material will outline the fistula and demonstrate its entrance into the rectum; this procedure will determine the size and length of the fistula and the location of the rectum. (Fig. 3.) In patients who have had a colostomy the distal loop may be visualized by the same method to demonstrate fistulous communications and the position of the rectal pouch. (Fig. 4.)

TREATMENT

The treatment of congenital malformations of the anus and rectum will vary with the type of anomaly and may involve a simple surgical procedure or a series of staged operations. The principles of preoperative and postoperative care are highly important requiring a knowledge of fluid and nutritional requirements.[3]

Stenosis of the anus or rectum is treated with repeated dilations of the stricture. A membranous obstruction of an imperforate anus is cured by a cruciate incision of the membrane followed with repeated dilations.

When the rectal pouch ends some distance above the imperforate anus, the type of operation depends upon the position of the rectal pouch and the possibility of reaching it by a perineal approach. The technic of the perineal operation is that described by Ladd and Gross.[17] (Fig. 5.) The suture material used in the following descriptions of operations is No. 00000 silk on a small atraumatic needle. With the infant in the lithotomy position an anteroposterior incision is made to extend from the scrotum or

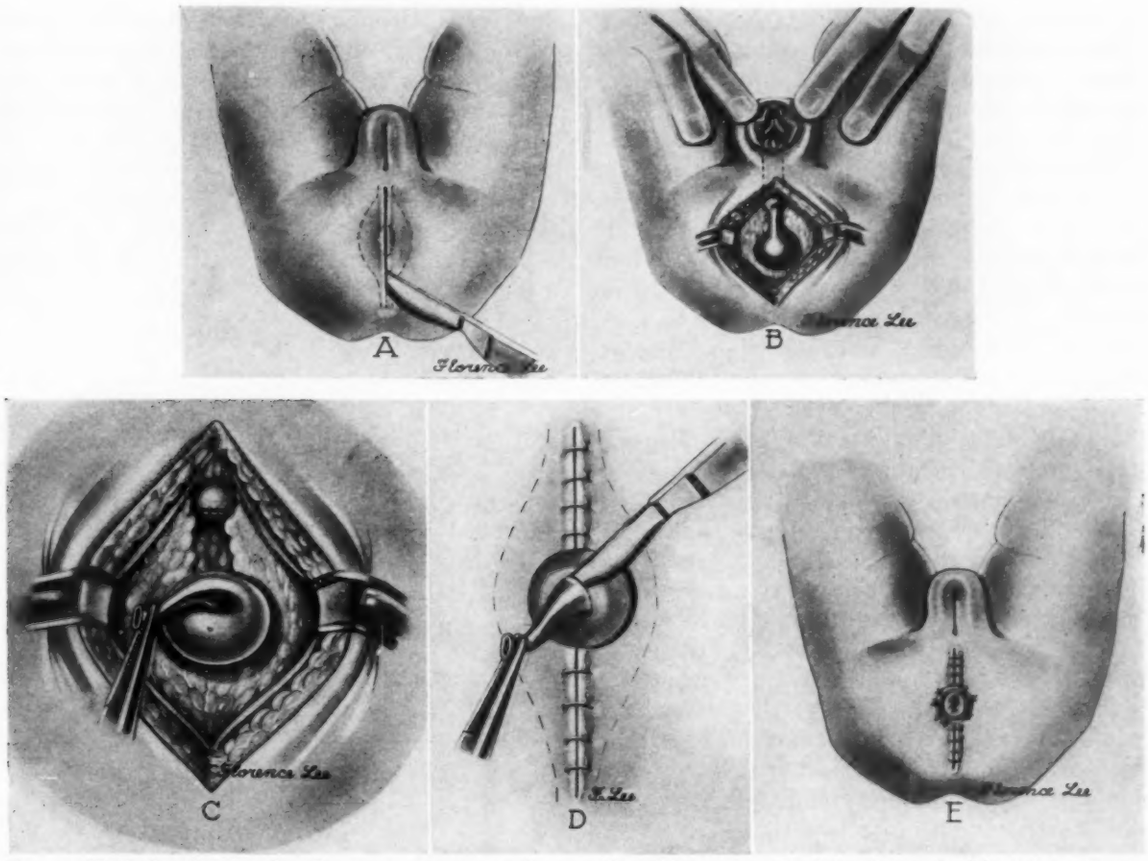


FIG. 5. Technic of operation for type III anorectal anomaly with rectovaginal fistula. A, incision through the imperforate anus dividing the anal sphincter muscle. B, exposure of the rectal pouch and the rectovaginal fistula. C, division of the vaginal end of the fistula and closure of the posterior rectal wall. D, mobilization of the rectum, exteriorization of the fistula and division of the rectal end of the fistula. E, suture of the rectum to the perianal skin and closure of the wound. (Redrawn from LADD and GROSS. Abdominal Surgery of Infancy and Childhood. Courtesy W. B. Saunders Co.)

vagina to the coccyx. The external anal sphincter muscle is divided in the line of incision. Dissection is continued through the perineal fat, the levator ani muscle and the pelvic fascia, keeping the exposure close to the hollow of the sacrum to avoid the urethra and vagina. Mobilization of the rectum is aided by traction sutures passed through the serosa and musculature of its distal end. The pouch is brought down through the pelvic fascia, the levator ani and anal sphincter muscles to the perineal skin. The levator ani and sphincter muscles and the skin are closed anterior and posterior to the rectum, the rectal pouch is opened and the edges of the rectum are sutured to the surrounding skin with interrupted sutures.

Subsequent anal dilations are very important. These are started during the second postoperative week by gentle insertion of the fifth finger. They should be conducted daily throughout the hospital stay and continued by the parent until the anus feels and functions normally.

If the rectal pouch is 5 cm. or more above the anal pit, the surgeon will experience difficulty in mobilizing the rectum. In addition there may be so much tension on the suture line that necrosis and a poor result are obtained; later resultant anal stricture and fecal incontinence may result. Under these conditions a primary colostomy is preferable. In such cases, too, if the perineal approach is unsuccessful, it must be followed with a colostomy, with a resultant high mortality (eleven deaths in thirteen cases[17].)

The sigmoid colon is chosen for the site of colostomy.* Operation is performed through a small oblique incision in the left lower quad-

* Recent experience has shown that the transverse colon is a preferable site of colostomy, with less interference with the surgery of future operative procedures.

rant of the abdomen, dividing the oblique and transversus muscles in the direction of their fibers. A spur is created by approximating the proximal and distal loops of the sigmoid with interrupted sutures. The sigmoid is divided between small crushing clamps, the proximal and distal ends closed over the clamps with continuous sutures and the clamps withdrawn. The loops are then approximated to the parietal peritoneum with a few sutures. The small remaining portion of the abdominal wall is closed after placing a small packing around the exteriorized bowel. Subsequent care of the colostomy presents no problem and requires simple cleansing of the skin. The formation of inspissated stool in the distal limb of the sigmoid can be prevented by a complete division of the sigmoid at the primary operation.

Further operative procedures are necessary in patients in whom a colostomy is performed. These are a reconstruction of the rectum through the perineum and closure of the colostomy. The completion of secondary operations is advised before the child is three years old. Beyond that period the child with a colostomy becomes cognizant of the fact that he or she is not a normal individual, and one must consider the possibility of atrophy in a non-functioning anal sphincter.

The treatment of associated fistulas varies with the type of fistula. Dilation of fistulas should be rarely done and only if the child's condition is poor. Rectoperineal and low rectovaginal fistulas are easily repaired. The technic of the previously described perineal operation is employed. (Fig. 5.) The fistula is completely excised and any internal opening is closed. The rectum is sufficiently mobilized to exteriorize the rectal end of the fistula, the opening of which is utilized for suture to the perianal skin. Attempts to close rectourinary and high rectovaginal fistulas in infants are usually unsuccessful and should be deferred to a later age. A preliminary colostomy will aid in healing, and relief of the rectal obstruction may result in the spontaneous obliteration of such a fistula. Division of the fistula through an abdominal approach may be required. A preliminary suprapubic cystotomy will be necessary in the repair of large rectourinary fistulas. The cystotomy will close with removal of the tube, and finally the colostomy is closed. Primary abdominoperineal procedures have been employed by Rhoads, Pipes and Randall[22] and by Norris, Brophy and Brayton.[20] This operative approach obviates the staged procedures employed for the cure of patients in whom the rectum ends at a great distance from the anal pit, with or without associated fistulas.

TABLE I
RESULTS OF OPERATIONS FOR TYPE III ANORECTAL ANOMALIES

Author	Abnormality Cured*	Abnormality Uncured*	Operative Mortality (per cent)
Ladd and Gross[17]	116(15)	27(19)	24
Bacon and Hering[4]	34	14(4)	8
Norris, Brophy and Brayton[20]	39(7)	5(1)	18
Fichet[12]	8(1)	8(8)	56
Crowell and Dulin[8]	9	4(3)	23
Rosenblatt and May[24]	8	4(2)	16
Lee[18]	4	7(4)	36
Dmytryk[10]	3	7(7)	70

* Numerals in parentheses indicate deaths.

RESULTS

The results of treatment will vary with the type of anomaly and associated fistula, the condition of the patient, the presence of serious associated congenital anomalies, the surgical judgment and technic, and the pre- and postoperative care of the patient. These factors must be evaluated in order to have a more accurate knowledge of the results. Patients should be examined at intervals to the period when bowel habits have been established in order to determine the degree of control of evacuation.

The largest experience with congenital anomalies of the anus and rectum has been that of Ladd and Gross.[17] These authors reported on 155 patients in whom the abnormality was cured and eighteen deaths, and fifty-nine patients in whom the abnormality was uncured and thirty-nine deaths, giving a mortality of 26 per cent. By groups the mortality rates were as follows: type I, 8 per cent; type II, 11 per cent; type III, 26 per cent; type IV, 57 per cent. Seventeen deaths were due to associated congenital anomalies.

The postoperative mortality of other authors was as follows: Bacon and Hering,[4] seven

deaths in eighty-seven cases (8 per cent); Norris, Brophy and Brayton,[20] nine deaths in fifty-nine cases (15 per cent); Harken,[14] nine deaths in twenty-five patients (36 per cent); Crowell and Dulin,[8] four deaths in twenty-three cases (17 per cent); Rosenblatt and May,[24] two deaths in twenty cases (10 per cent); Berman,[5] three deaths in eighteen cases (16 per cent); Dmytryk,[10] seven deaths in fifteen cases (46 per cent).

Since the type III anomaly is the one most frequently encountered and the one in which associated fistulas are most common, the surgical results of various authors are summarized in Table I. This shows 221 patients in whom the abnormality was cured and twenty-three deaths, and seventy-six patients in whom the abnormality was uncured and forty-eight deaths, giving an operative mortality of 24 per cent.

The surgical results of treatment of fistulas associated with the type III anomaly are summarized in Table II. This shows the following: rectovesical fistulas: eight patients cured, twenty-six patients uncured with eleven deaths (operative mortality 32 per cent); rectourethral fistulas: nine patients cured, twenty patients uncured with fifteen deaths (operative mortality 52 per cent); rectovaginal fistulas: sixty-four patients cured, twenty-seven patients uncured with five deaths (operative mortality 5 per cent); rectoperineal fistulas: twenty-seven patients cured, two patients uncured with no deaths (operative mortality 0 per cent). The over-all results were 108 patients cured and seventy-five patients uncured with thirty-one deaths, giving an operative mortality of 17 per cent.

TABLE II

RESULTS OF OPERATIONS FOR FISTULAS ASSOCIATED WITH TYPE III ANORECTAL ANOMALIES

Author	Type of Fistula	Abnormality Cured	Abnormality Uncured*	Operative Mortality (per cent)
Ladd and Gross[17]	Rectovesical	4	14(7)	39
Lee[18]		1	5(2)	33
Crowell and Dulin[8]		1	2	0
Bacon and Hering[4]		2	0	0
Berman[5]		0	2(1)	50
Fichet[12]		0	1	0
Rosenblatt and May[24]		0	1	0
Dmytryk[10]		0	1(1)	100
Ladd and Gross[17]	Rectourethral	2	10(7)	58
Chandler[7]		2	1	0
Bacon and Hering[4]		3	0	0
Helwig[15]		0	3(3)	100
Lee[18]		1	1(1)	50
Berman[5]		0	2(1)	50
Fichet[12]		0	2(2)	100
Crowell and Dulin[8]		1	0	0
Dmytryk[10]		0	1(1)	100
Ladd and Gross[17]	Rectovaginal	22	14(3)	8
Bacon and Hering[4]		23	3	0
Rosenblatt and May[24]		5	1	0
Crowell and Dulin[8]		2	4	0
Fichet[12]		5	1	0
Berman[5]		3	1	0
David[9]		2	0	0
Dmytryk[10]		0	2(1)	50
Chandler[7]		1	0	0
Carter and Lyall[6]		1	0	0
Lee[18]		0	1(1)	100
Ladd and Gross[17]	Rectoperineal	24	0	0
Crowell and Dulin[8]		1	2	0
Bacon and Hering[4]		2	0	0

* Numerals in parentheses indicate deaths.

TABLE III

METHODS AND RESULTS OF OPERATIONS FOR FISTULAS ASSOCIATED WITH TYPE III ANORECTAL ANOMALIES

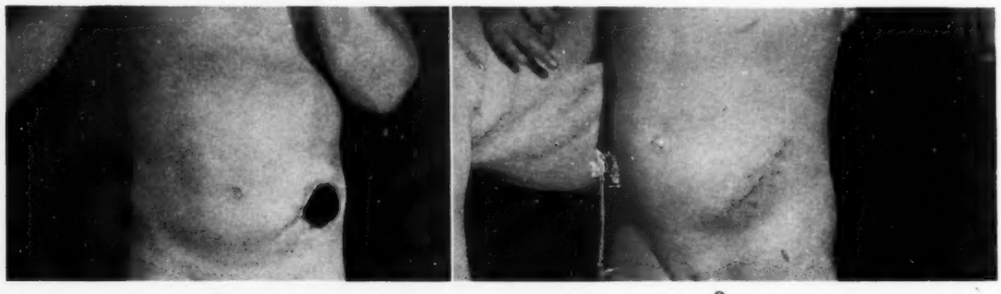
Types of Fistula and Treatment	Abnormality Cured	Abnormality Uncured
Rectovaginal:		
Staged operations	3	..
Colostomy (age 2 da. to 1 mo.)	..	..
Perineal operation and excision of fistula (age 1½ to 2 yr.)	..	..
Closure of colostomy (age 1 yr., 8 mo. to 2 yr.)	..	..
Perineal operation and excision of fistula (age 1 wk. to 1 mo.)	2	..
Rectoperineal:		
Perineal operation and excision of fistula (age 2 wk. to 2 mo.)	3	..
Rectovesical:		
Staged operations	2	..
Colostomy (age 2 da.)	..	..
Perineal operation (fistula closed) (age 2½ yr.)	..	..
Closure of colostomy (age 3 yr.)	..	..
Rectourethral:		
Colostomy (age 1 da.)	..	1

The author's results of treatment in eighteen cases of congenital malformations of the rectum and anus, all of type III, were as follows: fourteen patients cured and four uncured, with three deaths (16.6 per cent mortality). The three deaths were due to other associated congenital anomalies.

There were eleven cases of atresias of the rectum and anus with associated fistulas. The types of fistulas, operative procedures and re-

6A 6B

FIG. 6. Female infant after operation for atresia of the rectum and anus and rectovaginal fistula. A, photograph of the perineum taken during the first postoperative week showing normal position of anus and slight prolapse of rectal mucous membrane; B, photograph of the perineum at the age of six months showing normal anus (sphincter muscle had good tone).



7 8

FIG. 7. Photograph of male child at the age of two years with staged operations for atresia of the rectum and anus and rectovesical fistula, showing sigmoid colostomy.
FIG. 8. Photograph of female child at the age of two years after staged operations for atresia of the rectum and anus and rectovaginal fistula, showing scar of colostomy closure.

sults are outlined in Table III. There were no deaths in this group. Typical end results are illustrated. (Figs. 6 to 8.)

COMMENT

The primary considerations in any discussion of congenital malformations of the rectum and anus, as in all surgical conditions, are reduction of mortality and good functional results. The factors in mortality are the following: (1) the poor condition of infants who are born prematurely or have serious associated congenital anomalies; (2) delayed operation due to late diagnosis; (3) inadequate supportive therapy; and (4) inadequate surgery. Fortunately all of these causes with the exception of the first are being successfully eliminated.

Staged operative procedures, successfully completed by the second and third years of life, have been employed in five cases in this series in which the rectum ended high in the pelvis or above the pelvic brim and in which there were rectourinary or high rectovaginal fistulas. The only objection to these procedures is the increase in the number of hospital admissions and morbidity; however, this can be reduced. A primary abdominoperineal operation offers the advantages of correcting the rectal and anal deformities and closing the fistula in one operation. Experience will determine which of these procedures is the safest.

If diagnosed early there is no great emergency about operating upon these infants as in mechanical intestinal obstruction due to other

conditions. Although there have been occasional inaccuracies in the roentgen interpretations, more complete reliance can be placed upon this diagnostic aid after the first twenty-four hours of life. It would not be good judgment to perform an abdominoperineal operation in a case in which the rectum ended a short distance above the perineum unless it was associated with a high fistula.

A good functional result depends upon an operative technic which will not seriously damage the anal sphincter muscles, and careful and prolonged postoperative treatment.

SUMMARY

The embryologic, pathologic and clinical features and the treatment of congenital malformations of the rectum and anus are reviewed. Special reference is made to the treatment of eleven cases of the type III anomaly with associated fistulas.

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COMBINED ABDOMINOPERINEAL RESECTION FOR CARCINOMA OF THE RECTUM*

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SINGLE stage combined abdominoperineal resection is probably the most commonly used surgical method in the treatment of carcinoma of the rectum. New growths in this region do not commonly cause obstruction, but in the occasional case that does a two-stage procedure may be performed. In a very small percentage of cases perforation with localized abscess formation may have occurred; here, too, some type of two-stage procedure may be indicated. In elderly poor risk patients some surgeons prefer to do preliminary colostomy followed with a posterior resection. The present report deals with only those patients on whom the surgeon was able to carry out successfully a single stage combined abdominoperineal resection for carcinoma of the rectum. Patients requiring a two-stage procedure, or those in whom operation was deemed inadvisable due to local extension, fixation or distant spread to the liver or other organs, have also been excluded. Patients in whom the new growth was above the level of the reflexion of the peritoneum from the rectum, or the so-called rectosigmoid juncture, have also been excluded. This was done because many patients with such lesions have been treated by us with anterior resection and primary anastomosis. We have never used the so-called "pull-through" operation for carcinoma of the rectum.

A recent report by Bleicher[1] pointed out that the results of surgical procedures for neoplasms of the rectum and colon had come largely from teaching institutions or from institutions devoting their efforts to the treatment of neoplastic disease. He reported on a series of patients with cancer of the colon and rectum treated at the Wichita General Hospital in Wichita, Kansas, and in which the mortality and morbidity rates were much higher than those ordinarily reported in the literature. He also pointed out that most of the statistics in the literature had sprung from the larger centers for cancer therapy and from the large clinics and teaching institutions. He also showed that only a few of these patients operated upon in his series have five-year survivals. He referred to Ewing's[2] report made at an earlier date and concluded that "Ewing's criticism of the unsatisfactory treatment of cancer in the average general hospital is as valid today as it was twenty years ago." In the light of his findings we believed that it might be of interest to us as well as to others to report on our experiences with carcinoma of the rectum in which radical surgery was performed. An earlier report[3] dealt with neoplasms in the colon as well as in the rectum, and our experiences with their surgical management in a small general hospital.

MATERIALS AND METHODS

The patients on whom we had carried out single stage combined abdominoperineal resection for carcinoma of the rectum were asked to come in for examination. Those who failed to come in for examinations made reports by letter. The first patient was operated upon in December, 1943, and the last one on June 27, 1949. Most of these patients have been followed up very closely and have been seen by us in recent months. All of them were easily traced and the final result is known in the entire series. The group of twenty-five cases represents a consecutive series of patients undergoing surgery as pointed out previously. There was histologic proof of the diagnosis of cancer in each of the patients included in this series.

RESULTS

The results in this series of twenty-five cases is rather interesting. All of these patients remain alive, well and free of disease with the exception of four. One died about six months following surgery (Case No. A-8125), but apparently from an unrelated condition. One

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patient (Case No. C-1437) succumbed on his ninth postoperative day from a coronary occlusion. One died with pneumonia eight months postoperatively (Case No. B-6595) and one died in two months of widespread metastatic disease (Case No. B-8997). It will be noted from Table 1 that the first patient was operated upon in 1943 and remains alive, well and free of disease. She works daily.

TABLE 1

Patient and Case No.	Age (yr.)	Date of Operation	Result	Last Report
L. B. B-4991	63	12/9/43	Lived	Free of recurrence 7/49
W. G. A-868	46	5/23/44	Lived	Free of recurrence 7/49
G. A. A-3114	51	11/20/44	Lived	Free of recurrence 7/49
H. P. A-3555	57	2/13/45	Lived	Free of recurrence 7/49
C. W. A-5902	64	8/2/45	Lived	Free of recurrence 7/49
M. G. A-8125	69	3/23/46	Lived	Died 6 mo. postoperatively; cause unknown
F. A. B-8	52	9/12/46	Lived	Free of recurrence 7/49
G. S. B-171	60	9/25/46	Lived	Free of recurrence 7/49
A. McG. B-3113	46	6/20/47	Lived	Free of recurrence 7/49
M. B. C-961	65	9/27/47	Lived	Free of recurrence 7/49
E. P. C-1437	54	11/17/47	Died 9th da. of coronary occlusion	
A. H. B-4941	60	11/22/47	Lived	Free of recurrence 7/49
E. S. B-5763	76	2/15/48	Lived	Free of recurrence 7/49
M. D. B-6124	72	3/19/48	Lived	Free of recurrence 7/49
J. P. B-6595	77	5/3/48	Lived	Died 12/48 of pneumonia
J. McC. B-4911	66	9/1/48	Lived	Free of recurrence 7/49
M. G. B-8169	72	9/21/48	Lived	Free of recurrence 7/49
T. S. B-8337	38	10/5/48	Lived	Free of recurrence 7/49
H. S. B-8534	71	10/12/48	Lived	Free of recurrence 7/49
S. R. B-8997	48	11/30/48	Lived	Expired 2/16/49, recurrence
O. P. B-9619	73	2/2/49	Lived	Free of recurrence 7/49
H. K. B-9735	65	2/7/49	Lived	Free of recurrence 7/49
C. E. F. C-81	61	3/7/49	Lived	Free of recurrence 7/49
M. D. C-523	64	4/8/49	Lived	Free of recurrence 7/49
F. R. C1328	62	6/27/49	Lived	

COMPLICATIONS

The complications occurring during the management of these patients can be better described by grouping them into those complications occurring during surgery, those occurring during the immediate postoperative period and those which occurred late in their postoperative course or in subsequent years. Perhaps the most common untoward occurrence during the operative procedure was that of mild hemorrhagic shock. In the earlier cases this seemed to be most severe and was sometimes profound immediately following changing the patient from the supine to the lithotomy position in order that the perineal part of the procedure might be performed. This seemed to be controlled very well by starting blood immediately prior to this part of the procedure. No serious surgical accidents were encountered in this series of patients. It was necessary to remove portions of the prostate gland in two, and in one patient injury to the external urethra was sustained. This was recognized and sutured with fine catgut about the retention cathether, and the patient had no untoward symptoms. In one patient it was necessary to carry out total panhysterectomy with removal of the posterior vaginal canal in order to excise the primary neoplasm and its associated extension completely. There were no instances of ureteral injuries or of injury to the urinary bladder. A large vein on the left lateral pelvic wall was entered during the perineal portion of the dissection in one patient with resultant very massive and acute hemorrhage. This was rather easily controlled by controlling the immediate bleeding with a pack and then suturing the vein with No. 0000 catgut on an atraumatic needle.

The complications occurring during the immediate postoperative period and during the patient's hospital stay were rather numerous and varied. Pus in the urine with some type of bladder difficulty was almost universal. Several patients had considerable difficulty re-establishing the bladder control, but eventually all of them were successful and voided without difficulty. One patient, a male, about five months postoperatively had some difficulty, but he has an enlarged prostate and may need prostatic resection. There were no serious wound infections or wound eviscerations. None of these patients had thrombophlebitis and there were no instances of fatal pulmonary embolism. Severe, acute bronchitis occurred in one patient, and atelectasis developed in one patient. Both of these responded

well to conservative measures. One patient was anuric for approximately forty-eight hours following surgery although during the first few hours after surgery there were a few blood-tinged drops of urine. Her urinary output remained quite scanty for several days, the non-protein nitrogen became markedly elevated and she had one convulsion. She eventually recovered and remains well at this time. Bloody urine from the catheter was noticed in an occasional patient, and it was thought perhaps this was due to trauma to the bladder from retractors. One patient's colostomy stoma retracted underneath the skin necessitating returning her to surgery for its reconstruction. This accident occurred on the second day and was immediately corrected. This same patient also exhibited transient palsy to the right arm, probably from pressure on the upper trunks of the brachial plexus incident to the Trendelenburg position. This cleared up rather rapidly. This same patient also had a mild toxic psychosis; she was the only one in the group exhibiting this complication. One patient had diarrhea from the colonic stoma; very severe dehydration developed and it was quite difficult to correct his fluid and electrolyte imbalance. This patient's colostomy stoma was a little longer than normal, necessitating subsequent cutting down at about the fourteenth or fifteenth postoperative day. One patient with congenital familial polyposis had a polyp prolapse into the colonic stoma, causing complete obstruction necessitating ileostomy. This patient subsequently underwent total colectomy, the colon showing numerous polypi and a second carcinoma in the descending colon. In one patient an abscess developed in the perineal defect which was easily drained by inserting a finger into the hollow of the sacrum. In one patient the edge of the colonic stoma became gangrenous and sloughed away to the level of the skin edge of the abdominal wall.

The late complications are not numerous but undoubtedly will become greater as a longer time interval from the date of operation elapses. Very narrow colostomy stomas, both of them requiring plastic procedures, developed in two patients. One case was managed by incising the scar in the site of its original longitudinal direction and then closing it transversely. In the other patient retraction of the colonic stoma underneath the skin edge had occurred. This was managed by mobilizing the bowel and drawing about 3 cm. of it out above the skin of the abdominal wall. The first patient probably would not have experienced any difficulty had she practiced bi-weekly dilatations of the stoma. Two patients have some weakness of the reconstructed perineum and a slight impulse is elicited on straining. One is a female and the other a male. Both get along well by wearing an elastic girdle. A local recurrence in the sacral wound scar developed in A. McG. (Case B-3113), who subsequently underwent total colectomy for polyposis and multiple malignancies. This was treated with wide local excision and the patient remains free of visible recurrence.

TECHNICAL POINTS

There are many details concerned with the preoperative preparation, operative technic and postoperative care which must be carefully considered and properly carried out if the operation is expected to accomplish its aim of curing the patient of cancer. The diagnosis must be established preoperatively by means of biopsy and the bacterial content of the bowel lowered by means of enemas and chemotherapeutic agents. The patient's general condition should be brought into as good a state as possible, and facilities for combating shock must be established and ready before operation.

The anesthetic must be administered by a skilled anesthetist who is familiar with and able to use various combinations of anesthetic agents and technics and who understands shock and has the agents and methods established to forestall shock or to combat it if it occurs during the operation. It is taken for granted that the operating table, lights, instruments and other equipment are adequate. The personnel of the surgical team and the operating room nurses must understand the nature of the operation and the general principles of the technic to be performed, and must have made ready the necessary instruments, sutures and other materials to be used. These comments may seem superfluous, but long and occasionally unfortunate experience has convinced me to the contrary.

No effort will be made to describe the

technic of the operation as we have carried it out in this series of patients, but some comments on our experiences will be offered. The patient must have a catheter anchored in the bladder and it is helpful to have a colon tube in place. The latter aids in expelling gas from the distal segment of bowel and facilitates the packing of the bowel into the hollow of the sacrum prior to doing the perineal part of the operation. We have found it a safe and simple practice to divide the bowel with a cold knife, invert the distal end and tie a sponge over it with umbilical tape. This aids in diminishing the size of the mass to be placed in the hollow of the sacrum and makes the closure of the peritoneum of the pelvic floor easier. The proximal end of the bowel is brought out through a left McBurney type of incision, permitting uninterrupted closure of the primary incision. We have found a left lower paramedian incision extending from the left pubic tubercle to about 1 inch above the umbilicus to be the most satisfactory. If the space between the lumbar gutter and the colostomy spur is wide, no effort is made to obliterate it.

The perineal part of the procedure is performed with the patient in the lithotomy position because we believe this permits a quicker change of position, causes less shock and gives better exposure than other positions. We have continued to use a perineal pack composed of oiled silk and gauze. This aids hemostasis in the region of the sacral defect and gives firm support to the re-established and perhaps weak pelvic floor.

These patients must be given enough blood during the operation to prevent their blood pressure from falling to a shock level. It must be emphasized that this may require more than 1 L.

SUMMARY

Twenty-five consecutive patients undergoing single stage combined abdominoperineal resection for carcinoma of the rectum are reported. There was one hospital death, making a mortality rate of 4.0 per cent. One patient died of a recurrence in about two months, one died in six months and one in eight months of unrelated conditions. The remaining twenty-one are alive and free of recurrent disease from periods ranging from almost six years to a few months. Some of the complications encountered during the management of these patients are described and some comments on the technic of the operation are offered.

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COLORECTAL POLYPECTOMY*

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IT is now almost universally agreed that all suspicious accessible lesions of the lower sigmoid and rectum should be studied microscopically. Polypoid lesions of the rectum and lower sigmoid seen through the proctosigmoidoscope may vary in nature from benign through the various degrees of malignancy. While small biopsy specimens taken from various portions of the polypoid lesion sometimes provide the desired information, it is always better to have the entire polypoid growth made available for microscopic study.

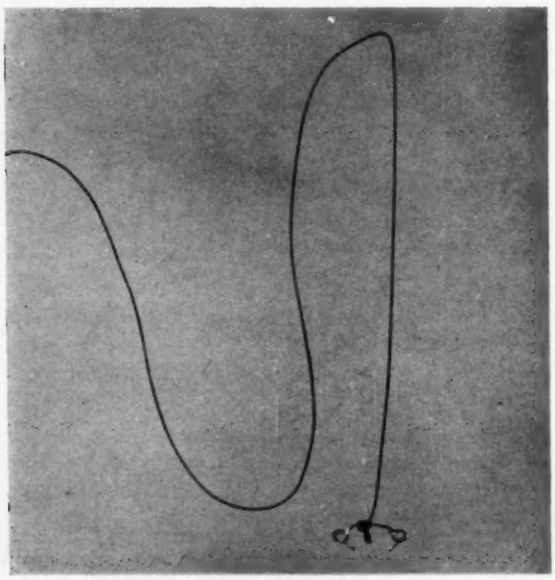

FIG. 1. Threaded Michel clip.

The following method of polypectomy is presented because it is easily performed and requires no special instruments other than those usually available in any hospital operating room. It also has other important advantages which are described later. The successive steps in performing rectal or lower sigmoidal polypectomy by this method are as follows: (1) The proctoscope or sigmoidoscope is passed to the site of the polyp. (2) A No. 11 Michel clip already threaded with a 12-inch length of black silk is introduced in the open jaws of a biopsy punch through the sigmoidoscope. The biopsy punch is then closed to engage the prongs of the clip into the free end of the polyp. (3) The biopsy punch is released and removed. (4) The loop of the wire snare is threaded onto the free protruding end of the black silk and introduced through the sigmoidoscope to follow the course of the silk thread directly to the polyp. (5) The polyp is manipulated with the silk thread using controlled tension to expose the superior as well as the inferior and both lateral surfaces of the polyp. The wire snare is then closed around the base of the polyp or around the base of the pedicle whichever the case may be. (6) The silk thread is withdrawn through the proctoscope and carries with it the attached metal clip with its prongs imbedded in the intact polyp. (7) The base of the polyp is further fulgurated as indicated. (8) The proctosigmoidoscope is withdrawn. (Figs. 1 to 6.)

The specific advantages of this method are the following: The polyp having been visualized and having been grasped by the Michel clip remains in the field of vision regardless of the movement of the proctosigmoidoscope and regardless of any movement of the patient. A high-lying polyp on a long pedicle is prevented from dropping back into the sigmoid beyond reach; this otherwise might occur because of the inverted position of the patient and the introduction of air into the sigmoid through the sigmoidoscope. The best visibility of the polyp is maintained throughout the operation because all instruments have been removed from the line of vision; the single strand of black silk is all that remains within the lumen of the proctosigmoidoscope. The wire snare is guided directly to the polyp by following the course of the silk thread. By controlled tension of the

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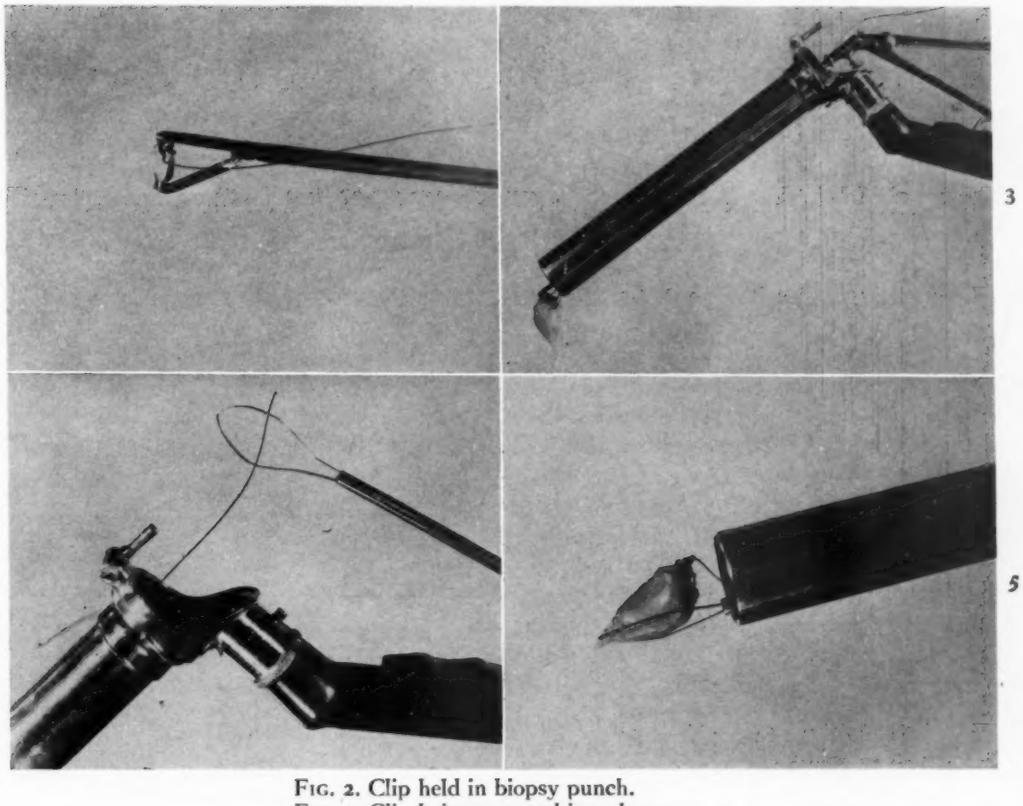

Fig. 2. Clip held in biopsy punch.
Fig. 3. Clip being engaged in polyp.
Fig. 4. Beginning passage of wire snare.
Fig. 5. Excision of polyp with wire snare.

silk thread with the clip attached and by manipulation of the sigmoidoscope, the superior as well as the inferior and both lateral surfaces of the polyp are visualized. The wire snare can then be tightened around the base of a sessile polyp or around the mucosal attachment of a pedunculated polyp. The polyp cannot be lost in the lumen of the bowel; it is firmly grasped by the metal clip which is extracted through the sigmoidoscope with the silk thread. The entire polyp rather than a section of it is made available for microscopic study; this is most important to determine the true nature of the polyp and to determine the possibility of basal infiltration. The simplicity of the method and complete control of the polyp during the operative procedure make for a saving of time; this minimizes the anesthesia problem when anesthesia is used and allows for certain patients to be operated upon without anesthesia. It also minimizes the possibility of circulatory and respiratory complications which sometimes occur because of the prolonged inverted position of the patient.

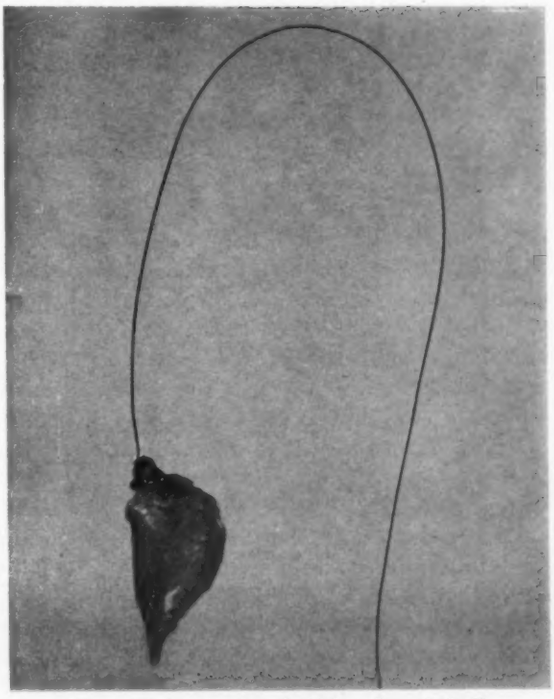

Fig. 6. Excised polyp held by threaded clip.

ANESTHETIC MANAGEMENT FOR MASSIVE INTRA-ABDOMINAL RESECTIONS*

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ANESTHETIC management for massive intra-abdominal resection is a problem of the present decade. While rare attempts at radical intra-abdominal resections were made prior to 1935, since that date several authors have reported a limited number of such procedures. As early as 1810[1] radical surgery of the stomach was proposed. However, it was not until 1881 that Billroth reported the first successful partial gastrectomy.[2] In 1884 the first known total gastrectomy was performed by Phineas Conner of Cincinnati but the patient died of shock in the operating room.[3] Carl Schlatter is credited with performing the first successful total gastrectomy in 1897.[4] The patient survived for one year and fifty-three days.

It has been reported that radical surgery of the pancreas, a total pancreatectomy, was performed as early as 1884 by Billroth.[5] In 1899 Halsted[6] successfully removed a carcinoma of the duodenal papilla and the diverticulum of Vater. The patient recovered from the original and a subsequent operation but died some months later of recurrence of the growth with blockage of the bile flow into the duodenum. Little apparent interest was shown in surgery of the pancreas from 1900 to 1935, and only sporadic reports appeared in the literature.[5,7,8] Sir Berkeley Moynihan[9] in 1926 when referring to surgery of the pancreas stated that "the result to the patient hardly justifies the means," and as late as 1927 Cohen and Colp[10] in a complete summary of the literature reported that only fifty-nine patients had received surgical treatment for carcinoma involving the duodenum or head of the pancreas. Whipple, Parsons and Mullins[11] in 1935 described their two-stage procedure for the surgical removal of carcinoma of the ampulla of Vater. This and a subsequent paper by Brunschwig[12] in 1937, who performed the first one-stage radical excision of the head of the pancreas, revived interest in radical intra-abdominal surgery so that during the last decade numerous operations and technics have been reported. In 1940 Whipple[13] successfully performed a pancreatoduodenectomy in one stage. Since then the literature reveals an increasing number of reports[14–21] of radical intra-abdominal resections indicating a growing enthusiasm for this type of surgery although the total number of such procedures still is relatively small.

Table 1

Primary Site	Number	Per cent
Stomach	24	21.8
Duodenum or ampulla of Vater	12	10.9
Pancreas	31	28.2
Colon or cecum	23	20.9
Gallbladder or common bile duct	9	8.2
Uterus	5	4.6
Ovary	3	2.7
Kidney	2	1.8
Adrenal	1	0.9
Total	110	100.0

We wish to present our experience in a series of 110 patients who were subjected to massive intra-abdominal resections. Many of the same physiologic problems also exist in intra-abdominal surgery for massive injuries; however, in this series the operations were for the excision of extensive malignant lesions with metastases. Table 1 presents the primary site of surgical problems concerned in the patients comprising this report. It is apparent that this was mainly in the upper abdomen where unfortunately lies the greatest number of vital intra-abdominal structures.

Since numerous organs were involved in these extensive and complicated surgical procedures, it is difficult to classify them as

* From the Department of Surgery of The University of Chicago, Chicago Ill. Aided by a grant from the Office of Naval Research, N6-ori-20, task order 11.

operative procedures *per se*. Table II presents a summary of the organs which were subjected to partial or complete resection.

In this series of 110 operations there were a total of 354 organs removed, either partially or *in toto*, or an average of 3.2 organs per patient. Massive resections of the pancreas, stomach, colon and duodenum accounted for ninety operations or 81.8 per cent, while the remaining twenty operations or 18.2 per cent were distributed among the gallbladder, uterus, ovary, kidney and adrenal. Surgery involving the uterus and adrenal had the highest number of structures removed, averaging four per operation, while ovarian surgery included only two organs per operation.

It is of interest that surgery on the colon or cecum resulted in the removal of a great variety of viscera. Of the twenty-three operations performed on the colon or cecum seventeen different organs were totally or partially removed as compared with resections of the stomach, duodenum and pancreas in which only nine, ten and twelve different structures were removed respectively.

The pancreas was resected more than any other viscera (sixty-three) with the stomach (forty-nine), duodenum (forty-one) and spleen (thirty-five) following in order. The pancreas, stomach, duodenum and spleen collectively accounted for 53.1 per cent of the total of 354 organs removed, yet more than seventeen different structures were resected.

In this series of 110 operations there were seventy-six (69.1 per cent) male and thirty-four (30.9 per cent) female patients. The age distribution appears in Table III. None of the patients were less than twenty years old and only two (1.8 per cent) were less than thirty years of age. The majority of the patients were over fifty years of age. Of the total, sixty-seven or 60.9 per cent were in the fifty to seventy age group while thirty-five or 31.8 per cent were from thirty to fifty years of age. Six patients or 5.5 per cent were above seventy years of age.

Table IV summarizes the pre-anesthetic risk of the 110 patients. Only nine (8.2 per cent) were considered as good anesthetic risks although fifty-three (48.2 per cent) were fair risks. A high number, forty-two (38.2 per cent), were considered poor risks while six (5.4 per cent) were classified as serious anesthetic risks.

The premedication in the majority of instances consisted of a combination of morphine sulfate and one of the shorter acting barbiturates, usually sodium pentobarbital. The premedication was administered one to one and a half hours prior to the scheduled time of

TABLE II

Primary Site	No. of Operations	Organs Removed or Partially Resected																		Total Organs Removed or Resected
		Stomach	Duodenum	Pancreas	Spleen	Liver	Gallbladder	Common Bile Duct	Jejunum or Ileum	Colon	Rectum, Anus	Omentum	Adrenal	Kidney, Ureter	Urinary Bladder or Urethra	Ovary	Uterus and Adnexa	Vagina	Abdominal Wall	Sacrum or Coccyx	
Stomach	24	23	8	15	15	3	..	..	4	..	..	3	..	1	..	..	..	..	2	..	74
Duodenum	12	7	10	10	..	3	1	5	3	1	..	2	..	..	..	..	..	..	1	..	43
Pancreas	31	14	19	31	12	4	1	13	7	1	..	1	1	..	..	..	..	..	1	..	105
Colon or cecum	23	3	2	3	4	3	3	1	9	21	2	2	..	2	1	3	2	..	7	2	70
Gallbladder	9	2	2	2	1	4	6	4	2	..	..	..	..	..	1	..	..	..	1	..	25
Uterus	5	..	..	..	..	1	..	..	..	3	2	..	1	..	4	2	4	3	..	..	20
Ovary	3	..	..	..	..	..	1	..	..	..	..	..	..	..	1	2	1	1	..	..	6
Kidney	2	..	..	1	2	..	..	..	..	1	..	..	1	2	..	..	..	..	..	..	7
Adrenal	1	..	..	1	1	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	4
Totals	110	49	41	63	35	18	12	23	25	27	4	8	4	6	7	7	7	4	12	2	...

surgery. It is judicious to prearrange the time so that the maximum effect of the premedication is reached before the induction of anesthesia.

The dosage of subcutaneous morphine sulfate varied from 0.0075 gm. to 0.010 gm.

TABLE III

Age (yr.)	Number	Per cent
0–19	0	0
20–29	2	1.8
30–39	16	14.5
40–49	19	17.3
50–59	35	31.8
60–69	32	29.1
70–79	6	5.5

TABLE IV

Risk	Number	Per cent
Good	9	8.2
Fair	53	48.2
Poor	42	38.2
Serious	6	5.4

while that of intramuscular sodium pentobarbital ranged from 0.12 gm. to 0.24 gm. The latter combination was, of course, varied depending on the physical status of the patient. In a small number of individuals no premedication was administered because of the poor or serious preoperative condition and in others only morphine sulfate was used.

Table v includes a summary of the anesthetic agents and methods used. Continuous spinal with procaine hydrochloride was the major basic anesthetic. This method was used in ninety-five patients or 86.4 per cent of the total. In nine operations, or 8.2 per cent, diethyl ether was administered as the basic agent; in five operations, or 4.5 per cent, a single spinal method was used while only one patient, 0.9 per cent, received local infiltration and anterior splanchnic block.

Of the 110 anesthetics administered a total of seventy-seven patients received supplemental anesthesia, that is, another agent or combination of drugs were given in addition to the basic anesthetic. The various supplemental agents and combinations are shown in Table v.

Of the ninety-five patients receiving continuous spinal anesthesia a total of sixty-three received supplemental drugs. However, of these sixty-three individuals in only ten instances was the supplemental anesthesia necessary because of failure or inadequacy of the basic spinal. In the remaining fifty-three patients additional light general anesthesia was used because of fatigue or restlessness, or at the request of the surgeon who wanted the patient to be unconscious so that medical discussions would not be overheard.

Of the five instances in which single spinal anesthesia injections were used supplemental agents were eventually necessary in all because of the long duration of the surgical procedure. The single spinal injection technic was used prior to the introduction of the continuous spinal method.[22]

Diethyl ether was used as the basic agent in

TABLE V

Basic Anesthesia	Total Number of Operations	Per cent	Supplemental Drugs										
			Nitrous Oxide	Ethylene	Cyclopropane	Nitrous Oxide Ether	Ethylene Ether	Cyclopropane Ether	Ethylene Curare	Nitrous Oxide Pentothal	Ethylene Pentothal	Pentothal Oxygen	Oxygen
Continuous spinal	95	86.4	18	30	1	5	4	..	..	2	2	1	32
Spinal	5	4.5	1	2	1	..	..	1	..	..	..	..	..
Ether	9	8.2	1	4	2	..	..	..	2	..	..	..	..
Local (procaine)	1	0.9	..	..	..	..	..	..	..	..	..	..	1
Total	110	100.0	20	36	4	5	4	1	2	2	2	1	33

nine patients and in all of these an additional drug, nitrous oxide-oxygen, ethylene-oxygen or cyclopropane-oxygen were used primarily for induction. On two occasions intravenous curare was substituted for deep ether saturation since the operations were prolonged and the patients were in serious condition.

COMMENTS

Preoperative Examination and Preparation. The preoperative studies and preparation of the patient will be governed by the nature of the disease and the type of surgery contemplated. In general the more severe the illness the greater will be the needs of the individual. Most patients undergoing radical surgery usually have some degree of protein depletion and hence are poor surgical risks. The protein depleted patient is more susceptible to shock in that his reserves are low; hence he does not tolerate blood loss and vasodilation well. Unfortunately, protein depletion may be present but may go unrecognized as the plasma protein concentrations are often preserved at near normal levels at the expense of a reduced plasma volume. In such patients careful attention to the dietary history and to weight loss may forewarn of impending disaster. Transfusion of 500 to 1,000 cc. of whole blood to these patients the day before surgery will enable them to tolerate anesthesia and surgery better.

Dormant or active hemorrhagic states may exist in many patients prior to surgery. Some are made worse with operation while others make their appearance during surgery or in the early postoperative period. Certain preoperative studies are of value, including determination of the prothrombin content, blood clotting time, the platelet count, the bleeding time, icteric index, blood volume and hematocrit, plasma albumin and globulins, nonprotein nitrogen and chloride determinations. An attempt should be made before surgery to correct the deranged clotting mechanism. Complete laboratory studies are essential to determine the cardiac reserve and electrolyte and protein balance.

The use of a high vitamin diet is indicated and the administration of additional vitamin K to reduce the clotting time in prothrombin deficiency is essential. The glycogen reserve of the liver may be increased by a high protein and high carbohydrate diet while repeated preoperative blood transfusions are also indicated in most of these patients. The administration of adequate blood and plasma is effective in raising the protein level. No patient should be subjected to non-emergency surgery unless the plasma protein level is at 6.0 gm. or preferably 6.5 to 7.0 gm. per 100 cc. or more.[23]

The liver deprived of adequate carbohydrate tends to store fat.[24] At times the fat content may reach 15 to 30 per cent of the liver weight thus replacing much of the labile protein and carbohydrate reserves. While the administration of 5 to 10 per cent glucose will partially combat these disorders, a suitable source of nitrogen is essential if the protein stores are to be replenished. The most efficient sources of parenteral nitrogen are blood and plasma.[25] Protein hydrolysates are of value but are much less efficient and are better used for body maintenance than for preoperative correction of hypoproteinemia. The advantages of plasma and blood over present day hydrolysates can be explained by the fact that nitrogen of blood and plasma is almost completely retained even when 2 to 3 L. are given per day. The rapid urinary loss of nitrogen following administration of protein hydrolysates makes for a nitrogen retention of about one-third (or less) that achieved when comparable amounts of plasma or blood nitrogen are given.

Ravdin[26] has shown that postoperative death from liver failure can be prevented in some cases by a high preoperative nitrogen intake. Safe anesthesia, therefore, must consider not only the period of its administration but also the preparation of the patient for the anesthetic.

Anesthesia. Schlatter[4] in describing the technic of total gastrectomy mentioned the use of ether as the anesthetic agent. Whipple[11] and Brunschwig[27] recommended the use of spinal anesthesia because of the advantage of profound muscular relaxation which is produced by this method. Recently various methods[28–31] have been reported for use in massive resections including spinal anesthesia, ether, cyclopropane and nitrous oxide in combination with pentothal sodium® and curare. Several surgeons have accredited advances in anesthesia as playing an important contributing role in the progress of radical surgery.

We believe that continuous spinal anes-

thesia with procaine hydrochloride produces the most favorable results. The use in divided doses of the least toxic of the local anesthetic drugs provides a wide margin of safety to the patient and shortens the period of postanesthetic recovery. In combination with the administration of mask oxygen the respiratory exchange and oxygenation of vital tissues is adequate. With this type of anesthesia there is a minimum of fluid loss from perspiration and vomiting both in the operating room and during the postoperative period. Patients are conscious and oriented on their return from surgery thus minimizing the possibility of accidents during this period. This is particularly important in view of the almost universal lack of adequate postoperative nursing care.

We have used the technic of Lemmon[22] using the malleable needle which is introduced at either the second or third lumbar interspace. Procaine hydrochloride in a 5 per cent solution with spinal fluid was used. This drug was preferred to other agents because of its minimal toxicity, rapid detoxification and unusually small number of side reactions. The initial dose of procaine hydrochloride ranged from 100 to 150 mg. (2 to 3 cc. of solution) in most instances while subsequent additional injections of 25 to 50 mg. (½ to 1 cc. of solution) of procaine hydrochloride were given at approximately thirty-minute intervals after the first hour of surgery, depending upon the condition of the patient and the needs of the surgeon. The initial sensory level of anesthesia varied from T-7 to T-2 depending upon the site of surgery. This level was obtained by careful positioning and examination of the patient immediately after the injection of the drug into the subarachnoid area, being mindful of the fact that each injection required an average of ten to fifteen minutes to become finally fixed. These same precautions were taken following each subsequent injection of procaine hydrochloride. Intercostal activity was carefully observed.

Circulatory Disturbance during Surgery. Disturbance of the circulatory system provided the main difficulty in our series. Sudden and profound surgical shock from profuse hemorrhage was the greatest single menace to the patient. Since a large number of these individuals presented metastatic lesions involving many organs and often large blood vessels, while others had previously received extensive roentgen therapy with the subsequent formation of masses of adhesions and excessive vascularization of the area, excessive oozing or sudden gross hemorrhage was of not infrequent occurrence during surgery. Bleeding in the form of prolonged oozing is also a problem in patients with carcinoma of the head of the pancreas or of the ampulla of Vater which produces an obstruction to the flow of bile and consequently jaundice and liver dysfunction. It has been shown that there is a great tendency for the icteric patient to bleed profusely. This inclination to bleed in most cases is due to prothrombin deficiency which may result from poor absorption of vitamin K and inadequate production of prothrombin by the severely damaged liver. In others, hypertension of the superior mesenteric veins obstructed proximally makes bleeding brisk when vascular injury occurs.

Analeptics, including ephedrine, desoxyephedrine, neosynephrine, oenethyl and caffeine with sodium benzoate were administered to many of these patients but only as adjuvants until proper fluid replacement could be accomplished. In profound shock the beneficial effect from the use of such agents is questionable and even condemned by some authors.[32,33] While these drugs may be used as a temporary expediency, they should never be substituted for blood or plasma, and in impending shock or during gross hemorrhage proper and rapid fluid replacement usually in the form of whole blood should be accomplished as quickly as possible.

As early as 1909 Crile[34] demonstrated experimentally and clinically that the giving of drugs in hemorrhage not only may be of no value but also may cause harm. He stated that the heart under most circumstances will work if it has anything to work with and needs blood or other suitable fluid rather than drugs. Transfused blood is the most valuable since it has the oxygen-carrying properties of the lost blood. He verified the opinion of Halsted and other observers of the value of transfusion after bleeding. He found that so long as there was any circulation animals could readily be resuscitated with blood transfusion without any later ill effects.

The relative efficiency of analeptic drugs is difficult to determine. Chemically epinephrine, ephedrine, neosynephrin and methedrine are closely related. However, clinically, these

drugs vary in rapidity of action and duration of effect. Oenethyl (tuamine), being an aliphatic amine, has a completely different chemical structure and our experience in a limited number of cases has been most gratifying. The use of epinephrine because of its potent action, short duration and untoward side reactions is to be discouraged.

Normal hemoglobin values should be established preoperatively and maintained during the operation and postoperative period. The oxygen saturation of the circulating hemoglobin should approach normal levels at all times. The recent development of the photoelectric oxyhemograph[35] affords a practical means for the continuous recording of oxygen saturation and is under investigation as an aid to the anesthetist. This and similar technics may prove of considerable value in regulating the oxygen requirements of patients not only during surgery but also in the critical postoperative period.

Electrolyte balance is important in reducing the hazard of anesthesia and operative procedures. Acidosis or alkalosis, whether from mineral imbalance or organic acid-base disturbances, should be corrected by the administration of the proper type and quantity of fluids.

Hemorrhage, because of disordered blood coagulation, is especially embarrassing to the surgeon and may confront the anesthetist with the requirement for unexpected transfusions to combat unusual blood loss. Whole blood transfusions are most effective in controlling the bleeding of prothrombin deficiency and are beneficial although less effective in hemophilia and thrombocytopenia. The preoperative use of vitamin K in patients with obstructive jaundice, liver disease and nutritional disorders is well established. Generally, operative hemorrhage will not occur if the prothrombin activity is above 60 per cent of normal. However, when the prothrombin level is reduced, it will frequently fall to a greater extent in the postoperative period and may cause serious bleeding. Both the operative procedure and the anesthetic agent are capable of further reducing the prothrombin time in the jaundiced patient so that vitamin K must be administered in the postoperative period if hemorrhage is to be prevented.

The volume of blood transfused during the operative period may be very large in massive operative procedures for malignant disease or extensive trauma. In fact, without the presence of an efficient blood bank radical surgery as now performed would not be feasible. The volumes of blood given during the preoperative, operative and postoperative periods to the patients comprising this report are listed in Table VI. The amounts given ranged from 550 ml. to 11,000 ml. and averaged 1,300 ml. Most of these patients received blood throughout the operation and in the postoperative period. In this same table the average amount of citrate given each patient with the blood transfused is tabulated. More recently as much as 14,000 ml. of blood have been administered during a single operation.

TABLE VI
VOLUME OF BLOOD AND CITRATE TRANSFUSED

Period	Total Volumes Given (cc.)	Average Per Patient (cc.)	Average Sodium Citrate (gm.)
Preoperative	60,700	550	2.0
Operative	133,400	1,300	5.0
Postoperative	104,600	950	3.5
Total	.....	2,800	10.5

When patients are given large volumes of blood or plasma rapidly, citrate intoxication may become a problem. Citrate is destroyed fairly rapidly in the body, being broken down to carbon dioxide and water, and excreted to some extent as calcium citrate. When the calcium ion is bound to citrate, very little "free" calcium remains so that symptoms of calcium tetany may appear when large volumes of citrated blood or plasma are rapidly given. Ordinarily, the administration of 1 L. of citrated blood or plasma per hour is not associated with clinical evidence of tetany even when this rate of transfusion continues for several hours.[36] However, since present methods make the ready estimation of ionizable calcium impossible, a suitable ionizable calcium salt can be administered at intervals to prevent tetany. The intravenous administration of 1 gm. of calcium gluconate after every 1,500 cc. of rapidly transfused whole blood or plasma is generally sufficient. There is no

danger of citrate accumulation making the blood incoagulable as death from tetany will occur before the clotting mechanism is altered.

Disturbance in Respiration during Surgery. During surgical intervention in a small number of patients lesions were found involving the diaphragm which necessitated resecting a part of the diaphragm and opening into the pleural space. As a result these patients then presented the problems of the "open chest" and had to be managed as such.[37] The mask method of ethylene-oxygen-ether anesthesia with increased positive pressure to maintain normal lung expansion and a generous amount of oxygen was adequate.

Manifestations of oxygen want secondary to circulatory disturbances were not infrequent. Such conditions as existing or impending shock, disturbed cardiac function and loss of large quantities of blood without adequate and rapid replacement caused a large number of these patients to show evidence of anoxia of the stagnant type.[38] The oxygen saturation of the circulating hemoglobin should approach normal levels at all times and the photoelectric oxyhemograph provides a rapid method for making such determinations. Spinal anesthesia has a definite advantage over other methods since a concentration of 100 per cent oxygen can be administered continuously by mask to these hypoxic individuals without danger of lightening the depth of anesthesia.

The usually reflex influence on the respiration under general anesthesia as manifested by laryngospasm, bronchospasm, hiccough and the like were not observed under spinal anesthesia. Curare produced intercostal and diaphragmatic paralysis in two patients who had experienced recent profuse hemorrhage.

Immediate Postoperative Management. Oxygen therapy was started at the termination of surgery. In the patients whose condition was critical at the end of the operation oxygen by the mask method was administered continuously during transport of the patient from the operating room to the division. Thereafter, oxygen was usually administered by oropharyngeal insufflation with a flow of 8 to 10 L. per minute while a few received oxygen by the mask method depending on the general condition and signs of oxygen want. Following surgery it was necessary to place one patient who had received curare in an automatic respirator for several hours because of inadequate voluntary ventilation.

Electrolyte balance must be maintained not only previous to and during surgery but also during the postoperative period. Acidosis or alkalosis, whether from mineral imbalance or organic acid-base disturbances, should be corrected with the administration of the proper type and quantity of fluids.

Renal function is often reduced after prolonged anesthesia and surgical operations. While many theories have been put forth to explain this phenomenon, the fact sometimes forgotten is that glomerular filtration depends upon the systolic blood pressure. It is important that the blood pressure never be allowed to fall to such levels that renal function is even temporarily impaired. Most patients are returned to the floor with normal blood pressure readings, but in some acute hypotensive states may develop a few hours later. These episodes may go untreated for some time during which period anoxia may lead to irreparable damage, and even though late treatment may restore the blood pressure, renal function may not be re-established. In our experience most patients with postoperative anuria or oliguria were in shock during or following surgery.

SUMMARY

A series of 110 patients who have undergone massive intra-abdominal surgery are reviewed. The anesthesiologists' problems preceding, during and following surgery are discussed and suggestions as to methods of management are presented. The importance of adequate blood replacement and oxygen therapy are emphasized.

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SURGICAL MANAGEMENT OF THE POST-THROMBOTIC SYNDROME*

WITH REFERENCE TO THE USE OF SYMPATHECTOMY

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SURGICAL experience has shown that venous clotting in the extremities will occur in 1 to 2 per cent of all major operations and after obstetric deliveries. In cases of patients who are bedridden without operation for either medical or surgical reasons the incidence of this condition will be high. Clotting likewise may follow trauma which may be direct, indirect, chemical or thermal in origin. In 40 per cent of the patients with varicose veins thrombosis occurs at some stage in their life.[1] In a few the lesion may develop without known cause. Thus the clotting may be primary or secondary to an inflammation of the vein.

As a result of this clotting in the vein certain pathologic changes occur in the vessel and the limb. In some the clot propagates proximally; and if inflammation is absent or minimal, it may become detached as an embolus. In others the inflammation causes sufficient irritation in the clot and vessel wall to keep the clot stationary.

In recent publications I have discussed the differentiation and early therapy of these two types of clotting. I suggested that much of the confusion in the diagnosis and treatment could be minimized by simplifying and standardizing the terms. Neologically, I[2] suggested that clotting be subdivided into two main types: (1) thrombosis in which the clot was primary and inflammation absent or minimal; this group causes the serious and fatal embolisms; and (2) thrombitis in which the primary condition was inflammation, the clot being of secondary origin and importance. Embolism in this group may occur but is less frequent and less serious than in the other type. In such a grouping the rarer suppurative clotting would be a complication of the thrombitis group. Such a classification would eliminate such terms as thrombosis, phlebothrombosis, thrombophlebitis, phlebitis, bland and silent thrombosis, thromboembolisms, etc.

PATHOGENESIS

In the early stages the two conditions vary both in their etiology and pathology. When seen late the pathologic picture becomes similar.

In thrombitis the superficial femoral vein usually is involved. The inflammation occurs first and then clotting develops. Spasm is initiated by afferent stimuli from the clot to the ganglia and efferent responses in the ganglia to the involved collateral vessels. As the inflammation extends, the venous return becomes occluded. Inadequate collateral vessels, some of which are in spasm, attempt to carry the load. With back pressure edema follows with the secondary skin changes and later ulceration.

This spasm is nature's defense mechanism to squeeze the blood out of the vessels before it clots and thus preserve the vessel for later use. In thrombitis the spasm continues to a pathologic state. Le Riche, Ochsner, Debakey, Gage and our own work have demonstrated the spasm factor. The valves fail, are destroyed and the superficial venous system also breaks down from the overload.

In thrombosis in the non-inflamed clotting the clot propagates along the vein wall and does not entirely occlude it for a time. When it does occlude, the pressure behind it builds up and embolism may follow. If there is no embolism, the clot becomes adherent by inflammation and massive edema follows.

SYMPTOMS OF POST-THROMBOTIC SYNDROME

Approximately 25 per cent of these lesions resolve spontaneously. One of three develops ulcers. A well defined symptom syndrome will develop in some of the patients who have had no therapy. This syndrome will develop in other patients despite all treatment. It is a well established one and may be called the post-thrombotic (causalgic) syndrome, the symptoms of which are as follows:

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Pain is always present. The degree of pain, of course, is dependent upon the patient's threshold, but it is a consistent symptom and is always worse when the leg is swollen. Most of the patients complain of pain at night. They are unable to get the leg in a proper position for rest. The patients are not too successful in localizing the area of pain, but in most it appears to be in the calf. Pains like electric shock occur at times.

Swelling of the leg is consistently present, greater on dependency, and always more apparent at night. It may gradually disappear and in many patients who are treated correctly it will be negligible at the end of six months. In others swelling is residual.

Many of these patients soon have typical symptoms of causalgia in which the degree of disability and complaints far exceed the clinical findings. Some patients become extremely hyperesthetic about the part and in this respect resemble patients with causalgia. Many of the patients discontinue wearing girdles or supports of any type on the leg. Mild trauma may cause more distress than a heavier one. Such patients are afraid to have the leg touched, and simple pressure causes a severe reaction.

The patients complain that the leg has a heavy, thick, "wooden" feeling. This is a constant finding.

Paresthesias are described as "a crawling" in the leg. Many of these patients when they stand up feel that blood or fluid runs down their leg, and this may be the settling of blood in a partly recanalized vessel. This is described as a "bubbling and gurgling" in the leg. Others have described it as a sensation of "worms" or "flies" crawling on their legs. The patients are concerned regarding their "circulation." Local areas of anesthesia may develop with this paresthesia but these are inconstant.

These patients may have attacks of fever, redness, pain and swelling like cellulitis. The vein will become hard and indurated. The attack usually responds to chemotherapy and warm packs but at times may be alarmingly severe. The pathologic condition increases after each attack.

The part becomes cold, atrophic, blue on dependency and in many the joints stiffen. The skin may be shiny and it may have tense, hard feeling like lymphedema. These changes may be aggravated due to disuse.

In approximately one-third of these patients ulceration appears. These ulcers begin usually at the end of a year; this is at the time when the superficial femoral vein is endeavoring to recanalize itself. The ulcer usually is on the medial aspect of the leg but it may develop laterally over the external malleolus. Multiple ulcers may develop. These ulcers are characterized by the extreme tenderness and pain and by their resistance to all types of therapy.

In many of these patients definite mental changes develop with this syndrome. The patients have a feeling that no one appreciates how much they suffer. These symptoms are multiplied by lack of sympathy from doctors and friends. In addition the failure to receive help from the many doctors they have seen has increased these signs. Most patients have been told that there is nothing to do for the limb, and this increases the feeling of depression. When there is a compensation or insurance background the mental part may be extremely aggravated for obvious reasons. Many patients retire for life.

EARLY OR PROPHYLACTIC TREATMENT

In the inflammatory type, even in the subacute or early chronic stage, sympathetic nerve blocks performed with 2 per cent novocain have a definite place in the therapy. The technic is relatively simple; it can be performed by any well trained physician and should be part of his therapeutic armamentarium.

The therapeutic basis for the use of warm packs is to relieve local vasoconstriction. That this is effective is shown by the marked relief of pain and edema when the packs are properly applied.

VASCULAR PACKS

(1) Cover the skin of the foot and leg with a coating of lanolin or vaseline.
(2) Over this wrap towels which have been wrung out of warm water.
(3) Place a hot water bottle next to the towel. Note: Not too hot.
(4) Wrap the entire limb in a blanket to maintain the temperature.
Caution: Important. Do not burn.
(5) Avoid standing and do not overuse the legs. Move the legs freely even in the pack and do not keep in one position too long.

Since there is a block to venous return from the limb, elevation of the part above the cardiac level will partly aid in this return. This

point needs emphasis. Support to the part is extremely important and its principles must be understood. The fluid exchange from the skin and superficial structures has been draining to vessels which are closed at this time. With elevation the load is decreased and the swelling goes down. With weight bearing adequate support from the toes to above the knees must be provided and continued. Failure to provide this support allows the stagnation of the tissue fluid in the subcutaneous tissues. This creates a large space between the skin and subcutaneous tissues, and if not corrected this space will become fibrosed and remain permanently. If swelling occurs, too much blood is being pumped into the legs in comparison to the available venous outlet. The legs then should be elevated immediately until this fluid has disappeared; this should be done each time swelling occurs. The legs then should be rebandaged to maintain the reduced size of the foot and leg.

Since spasm is a factor, all smoking should be eliminated permanently. The importance of this step in venous as well as in arterial lesions has not been emphasized sufficiently. Many of the patients will continue symptoms or have repeated recurrences if they continue their smoking. Even one cigarette may produce spasm. The possibility exists that nicotine may initiate thrombitis without spasm, and every day we have increasing evidence in this direction. We do know that in the nicotine-susceptible individual all other therapy fails if the patient continues his smoking.[1]

The legs should be kept moving. Bed rest causes stasis and tissue injury to the endothelium of the calf veins by pressure. These two factors plus a change in the blood clotting mechanism are the triumvirate necessary for further clotting.

A warm sitz bath helps to localize any infection and has a local vasodilatation effect.

In all instances in which there has been any inflammatory thrombitis chemotherapy should be used. These drugs are used emperically.

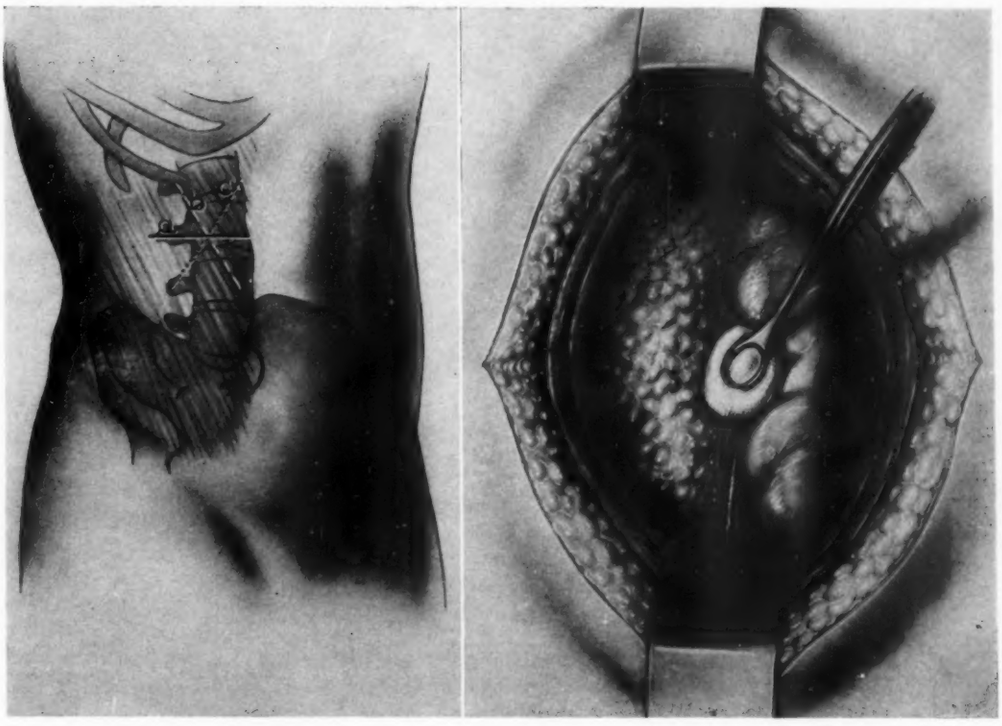
Fungus infection is universally present. It is more prevalent in those patients who have venous stasis because the extremities are more moist than normal. The use of a mild fungicide such as potassium permanganate, 1:10,000 to 20,000 in strength, for twenty minutes every one or two days is sufficient for its control. Although this does not cure the fungus infection, it does control it. Cotton pads at the tip of the toes will spread the toes and permit the solution to get into the fungus in the crevices near the bases. More strenuous efforts to control the fungus with such substances as salicylic acid or roentgen therapy is contraindicated because of the slough and tissue breaks which may follow.

The anticoagulant drugs now are an accepted part of this therapy. Heparin may be begun at once by the intermittent subcutaneous method and used for forty-eight hours until dicumarol® effect is noted. Parital may be substituted.* The patient is given 50 mg. of heparin intravenously. At the same time 50 mg. are injected deep in the subcutaneous tissues. At the end of two hours the coagulation time is taken. From 35 to 70 mg. of heparin are given subcutaneously every three hours thereafter, depending upon the coagulation time. The coagulation time should be kept between twenty and thirty minutes. Sudden drops in coagulation should be avoided. Usually the coagulation time taken two hours after the dose is sufficient, but there are exceptions to the rule; in these events the laboratory tests should be run more often. Depo-heparin has not had sufficient trial as yet. Dicumarol® therapy also is started at once, and 300 mg. may be given the first day. The Link-Shapiro modification of the Quick test is then performed and the prothrombin level lengthened to between two and three times normal. The dose of dicumarol® for each day is calculated on that day's prothrombin level. This anticoagulant therapy must be continued between fourteen and twenty-one days. In many these measures control the symptoms. Those who do not respond or who are seen late require further therapy.

ACTIVE TREATMENT OF POST-THROMBITIC SYNDROME

Sympathectomy. We have been impressed by the excellent results which followed treating the acute thrombitic patients with sympathetic nerve blocks, especially when combined with anticoagulant therapy. This therapy in some of the subacute thrombitic patients produce satisfactory results. In some of the chronic thrombitic patients sympathetic nerve blocks were tried and many of these patients reported themselves markedly improved; however, in most subsequently all the previous symptoms returned. It was our belief that if these patients could be temporarily improved by

* Tromexan also may be substituted.



1A 1B

FIG. 1. A, incision site; division of muscles in the line of fibers; skin incision at level of L11; (*a*) skin, (*b*) external oblique, (*c*) internal oblique and transversalis. B, peritoneum and contents pushed forward to expose psoas muscle; sympathetic ganglion chain in sulcus in the medial edge of the psoas. (From PRATT, G. H. Surgical Management of Vascular Diseases. Philadelphia, 1949. Lea & Febiger.)

blocks they could be helped permanently by surgical interruption of the sympathetic system. In 1939 one patient with chronic thrombitis, who had had several sympathetic nerve blocks with temporary relief, insisted that surgical sympathectomy be performed. After the operation the clinical improvement was remarkable. The patient stated that she had a "brand new leg," the heaviness was gone, all the paresthesia was absent and she could sleep well for the first time in several years. The edema gradually was reduced. That this was a true reaction was shown by the fact that she quickly sent two other patients with similar trouble to us for the same procedure. We have now performed this operation ninety-six times for the post-thrombotic syndrome. We have seen no untoward results from the procedure and all but two patients have had a clinical relief of symptoms. In many the edema has not entirely subsided; but when the sympathectomy has been combined with adequate support for a considerable length of time, the edema is reduced. The relief of the symptoms of anesthesia, coldness, paresthesia and heaviness in the limb is similar to those after sympathectomy for causalgia. The change in these patients' mental outlook is the most astonishing result. (Figs. 1 and 2.)

In selecting patients for sympathectomy the patient should be one who has had venous clotting and who has persistent symptoms, as described, despite conservative measures. He should respond temporarily to sympathetic nerve blocks. The patient who has cold legs with heaviness, paresthesia and anesthesia is the best candidate. The patient must have discontinued all smoking.

CARE OF THE THROMBOTIC ULCER

The post-thrombotic ulcer is one of the most disturbing and discouraging lesions with which one has to deal. The ulcers recur frequently despite all types of therapy and are extremely painful. An outline of measures we employ for their care follows. One or all of the measures may be necessary. The order of their trial is important. For example, skin grafting before the other measures are performed usually will

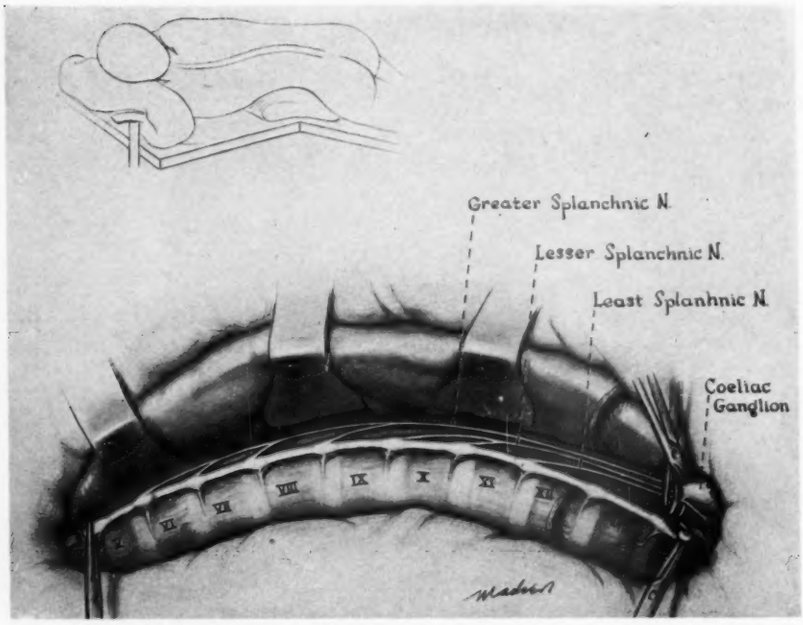


FIG. 2. Sympathetic chain and ganglia; for lower extremities LI, II and III are removed. In thoracolumbar sympathectomy ganglia from DV to LII are removed. (From PRATT, G. H. Surgical Management of Vascular Diseases. Philadelphia, 1949. Lea & Febiger.)

fail. Grafting is the end stage when the pathologic basis for the ulcer has been corrected or improved.

Ligation of Patbologic Veins. The usual four valves of the superficial femoral vein have been destroyed after the inflammation. We have proven this on repeated occasions. For example, in one instance in which there was a recurrent thrombotic ulcer just above the ankle a feeding vein was opened. Believing it wise to strip this vein I introduced a Babcock intraluminal type of stripper into its open lumen. The stripper slipped up the vein easily for its entire length unobstructed by any valves. Searching in the groin wound for the other end I found it directly in the superficial femoral vein. This maneuver has been repeated several times, indicating that in the resistant post-thrombotic ulcers the causative incompetent vein leads directly to a permanently defective superficial femoral vein. With the added load the saphenous system and its valves soon fail. In these patients then, with post-thrombotic ulcers we have a double problem, namely a superficial femoral system with valve failure, back flow and a reversed pressure of venous blood and a secondarily incompetent saphenous system.

The treatment requires inspection of the superficial femoral and profunda veins in the groin. If the superficial femoral vein is thickened, smaller than usual, and there is an adequate profunda system, the superficial femoral vein is ligated and divided. If temporary occlusion of the superficial femoral vein does not cause marked dilatation below the tie, it may be resected safely. The use of venous pressures to determine whether the superficial femoral vein may be resected has been abandoned as with experience this temporary block will give all the needed information. If the femoral profunda vein system is inadequate, the superficial femoral vein will distend when it is temporarily occluded. The greater and lesser saphenous systems in addition then must be treated by resection in the groin and at each incompetent point as is usual in simple varicose veins.

Sympathectomy. Resection of these veins may heal the ulcers. In others the pathologic condition is so advanced, the scarring and skin changes so extensive, that an increase in the capillary blood flow is required to close the ulcer. In these patients lumbar sympathectomy must be performed as was described.[3]

Skin Grafting. Healing then occurs unless there is so much epithelium lost that the problem is similar to an extensive burn. Skin grafts then are required, on the ulcer base if it is a satisfactory recipient site, or after the ulcer, the

base and the surrounding diseased skin have been surgically excised.

It may not be necessary to perform all of the steps advocated. In some cases in order to maintain the healing all of the procedures outlined are necessary. It is suggested that in the resistant ulcers the steps be undertaken in the order described. The surgical treatment can be stopped at any stage when healing of a permanent nature is achieved.

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In many patients with volvulus of the sigmoid emergency surgery is often accompanied with a high mortality. If the acute symptoms can be overcome by the use of a long rectal tube with temporary detorsion of the sigmoid, one can better prepare the patient for a subsequent elective operation in which the results and the operative mortality are much more satisfactory than operating on acute cases. Such elective surgery is advisable even with subsidence of the acute symptoms because otherwise in fully one-quarter of these cases recurrences subsequently develop. (*Richard A. Leonardo, M.D.*)

LEG ULCERS OF VASCULAR ORIGIN AND THEIR THERAPY

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VASCULAR leg ulcers are caused by venous, lymph or arterial pathologic disorders. Arterial obstruction may be functional as in Raynaud's disease or organic as in arteriosclerosis obliterans, diabetic ulcer, thromboangiitis obliterans and hypertensive ischemic leg ulcer.[1] Other leg ulcers not discussed here are due to infections, ulcerated malignant tumors, drug idiosyncrasy, avitaminosis, blood dyscrasias and diseases of the spinal cord.

CLINICAL PATHOLOGY OF STASIS AND VARICOSE ULCERS

Case histories usually reveal that prior to the development of gravitational ulcers the patients were affected with acute thrombosis or thrombophlebitis of the femoral popliteal or the iliac veins, or both, occurring post partum during prolonged bed rest or after abdominal operations or traumas. Occasionally gravitational ulcer develops spontaneously. The acute phase is called stage one by Swedish authors[2–4] and the following chronic phlebitis characterized by the sequelae of venous insufficiency, stage two. Linton[5] made the observation that ulcerations appear about one year after the onset of stage one. It is hoped that early application of anticoagulants and sympathetic blocks during stage one will prevent the crippling effects of stage two.

In deep chronic phlebitis the leg is frequently swollen. In the beginning the edema is pitting; later on it becomes irreversible and is frequently associated with calcium deposits or even ossification inside the dense fibrotic subcutaneous tissue. The valves of the veins are destroyed, and the lumina of the femoral and perforant veins become partly obstructed, their walls thickened and unamenable to the pumping action of the leg muscles. The venous pressure studies of Warren and associates[6] revealed that the intravenous pressure in the saphenous system of postphlebitic legs does not show the kinetic decrease of normal legs.

The superficial varicosities are frequently thrombosed or transformed into hard cords, or they may be palpated as open sinuses against the indurated subcutaneous tissue. The ulcer may be surrounded with chronic eczematous or dermatophytic dermatitis. Frequently the chronic eczema becomes generalized by injudicious use of ointments and powders.

Varicose ulcers do not show any pathologic disorder of the deep venous channels; only the saphenous system is degenerated and diseased.

CLINICAL PATHOLOGY OF ULCERS DUE TO ARTERIAL DISEASE

Arterial insufficiency as a cause of leg ulcers has to be suspected in patients whose oscillometric readings and skin temperature of the toes are below normal.

Buerger's disease may be found in middle-aged people and smokers. A migrant phlebitis should always suggest a search for other signs of thromboangiitis obliterans. The ulcerations here are found over poorly nourished skin areas like the tibial crests, malleoli and the tips of the toes. Missing reflex dilatation in cases of vasospasm or arteriolar obstruction is a useful diagnostic sign.

In occlusive arterial disease a rise in temperature will not follow sympathetic block[7] or intravenous injection of etamon[8] or priscoline.®

The elevated foot will turn pale, especially the sole of the foot (Samuel's sign[9]). In dependency normal color should return, and the veins should fill within 10 to 15 seconds. In the presence of occlusive arterial disease this restoration may take several minutes, the skin color changing to a cyanotic hue.[10]

The significance of the dorsalis pedis pulse has to be re-evaluated: In about 15 per cent of healthy persons the pulse cannot be palpated; on the other hand, its presence does not always exclude occlusion of arterioli peripheral due to artery.[10]

HOSPITAL THERAPY OF STASIS AND VARICOSE ULCERS

Patients with extensive ulcers should be hospitalized and bed rest enforced. It is remarkable how fast many ulcers heal under this

regimen. The infection should be combated with sulfonamides and antibiotics. Wet compresses with saline penicillin,[11] saline tyrothricin,[12] bacitracin[13] or furacin solutions[14] are recommended. Potassium permanganate baths (1:5000 solution) aid in clearing up fungus infection. Hypoproteinemia is treated with administration of proteins and amino acids.[15] Ascorbic acid, 1 gm. per day, is believed to be of value.[10] Thiamine chloride, 100 mg. per day, is used in cases of painful ulcers.[16] Shute[17] recommends mixed tocopherols (vitamin E). I have been unable to demonstrate any curative effect of these vitamins.

Skin Grafting. After the infection is checked and the granulations appear healthy, skin grafting may be undertaken. Pinch grafts (deep Davis grafts) are preferred because they take best. Padgett[18] and others recommend excising the ulcer and covering the defect with a "three quarter thickness" skin graft. Thinner split grafts of the Thiersch type seem to have a better chance of taking. Thrombin is used by Jenney[19] and others for internal graft fixation. Wet or vaseline dressings are applied to the graft with mechanic's waste incorporated into the pressure bandage as external fixation. Penicillin is given parenterally in adequate doses. The dressing is changed after eight days. The immediate results are usually satisfactory; recurrences, however, are frequent.[20]

Vein Ligations. After elimination of the infection and preferably after healing of the ulcer, the impaired venous circulation has to be corrected by ligations of the saphenous veins and of the incompetent perforators. Ligation of the superficial femoral vein has been tried by Buxton,[21,22] Pratt[23] and others. Linton[24] combines ligation of the superficial femoral vein with stripping of the saphenous vein as a routine operation. This treatment is still experimental. There is, however, accumulating evidence that the intravenous pressure of the saphenous system, which is increased in the postphlebitic states, is not improved by femoral ligation but actually increased to a higher degree than before the operation.[6]

AMBULATORY TREATMENT OF STASIS AND VARICOSE ULCERS

In ambulatory therapy occlusive bandages are used. Excluded from this treatment are generalized eczematisation and acute infectious complications.

With the exception of Lassar's zinc oxide paste, into which 2.88 per cent of crude coal tar might be advantageously incorporated,[25] ointments due to their macerating and sensitizing effect are not suitable for the therapy of leg ulcers. Naftalan, scarlet red and chloresium ointments do not promote wound healing and epithelization. Furacin ointment* may be used temporarily to clear up infections. The most effective media to check excessive secretion from wounds are powders, such as kaolin, talcum, bismuth subgallate, lythargyrum, mercury sulfide red or zinc stearate. Dried human blood cells[15,26] and blood gel pastes[27,28] have been used with some advantage. In 1944 I introduced a blood-kaolin-penicillin paste[29] which can be made easily from the patient's blood. Sulfonamide and antibiotic powders are useful in combating infection but have a high sensitization index. The same is true to a lesser degree of Gentian violet, Castellani's paint, furacin and even of zinc oxide ointment.

Technic of Bandaging. Over the ulcer, which is covered with powder or blood paste, a thin layer of gauze is applied. The surroundings of the ulcer are covered with Lassar's paste, and the remaining skin of the leg is greased with zinc oxide ointment. In an alternate method talcum or desenex powder† is applied to the whole leg to combat fungus infection.

In the next step the whole leg and foot are wrapped with a 3-inch gauze bandage and one layer of sheet wadding, which is then covered by a gauze bandage saturated with Unna's paste, by an elastoplast or ace bandage. The zinc-gelatin paste or the elastoplast bandage should never be applied directly to the skin[30] in order to avoid skin irritations leading to new ulcerations.[31]

Strapping of leg ulcers[32] is an ancient method. Although it procures occasionally good results, it should not be considered as a standard method.

A rubber sponge may be incorporated into the bandage over the ulcer area.[33]

Three types of bandages are available: (1) The pressure bandage exerts pressure upon the superficial and deep veins and decreases the total venous space of the leg. In conjunction with the contractions of the skeletal muscles it

* Manufactured by Eaton Laboratories, Inc., New York.

† Manufactured by Wallace & Tiernan Products, Inc., Belleville, N. J.

improves the impeded lymph and venous stasis. The pressure to be applied should be maximal up to the tolerance of the patient. It should be used only in legs with patent deep venous circulation (positive Perthes' test). (2) In the supportive bandage the pressure should be moderate, with the purpose of compressing the subcutaneous veins only and not the deep subfascial vein channels. It is the most comfortable bandage and has a wide therapeutic range. The pressure or supportive bandage should only be used in cases with unimpaired arterial circulation. (3) With the protective bandage no pressure at all is applied. Its purpose is to protect the limb against mechanical and thermal hazards and to keep topical medication in place. It is used in acute complications of phlebitic ulcers and in arterial disease.

Sigg[34] of Switzerland carries out a consequent compression therapy of varicose and phlebitic ulcers, using a 1-inch thick foam rubber sponge and two to three ace bandages, 3 and 4 inches wide. The sponge plus bandages have to be reapplied every morning by the patient himself, who is thoroughly instructed by the physician. This compression therapy is very economical, and the results as published by the author are remarkable.

Patients with uncomplicated venous ulcers should be encouraged to walk and to do wiggle exercises of the toes to promote venous and lymph circulation. Standing and sitting should be avoided.

Thickened ulcer margins are treated under local anesthesia with short radiary incisions at ¾ inch intervals. These incisions release congested blood and interstitial fluid, thereby contributing to the flattening of the indurated and edematous borders.

Undercutting of the ulcer base, frequently recommended,[35] is inadvisable since it cuts off the arterial blood supply and invites gangrene. Before a surgical procedure is contemplated, the integrity of the arterial circulation has to be proven.

Varicosities not obliterated by surgical ligation are treated with sclerotherapy. Special attention should be given to veins surrounding the ulcer. They should be injected with small amounts of sclerosing agent. Sotradecol* has been used with exceptional success.[36]

* Manufactured by Wallace & Tiernan Products, Inc., Belleville, N. J.

Sympathetic blocks and sympathectomy are recommended by Gravelle[37] and others. In my experience the interruption of sympathetic pathways does not contribute to the healing of gravitational ulcers. In painful ulcers in which a vasopastic factor can be demonstrated, paravertebral blocks or the administration of sympathiocolytic drugs like etamon or priscoline® is indicated.

THERAPY OF ULCERS DUE TO ARTERIAL DISEASE

It is based on entirely different principles. The therapeutic armament consists of rest, prohibition of smoking, protection of the affected extremity against mechanical, thermic and chemical traumas, the administration of sulfonamides and antibiotics against infection, and establishing collateral circulation and eliminating vasospasm with the institution of methods like novocain lumbar blocks, lumbar sympathectomy, the use of sympathiocolytic drugs (etamon[8] and priscoline[38]), Allen-Buerger exercises, Saunders' oscillating bed, rhythmic constriction, reflex heat to the abdomen, alcohol given orally and dilute procaine infusions intravenously. Depropanex and tetrathione apparently did not stay the test of the time. Intravenous ether infusions[39] have been abandoned after fatalities were reported. The value of vitamin E is not established.

The progress of the necrotic ulcers is very slow. They often represent the beginning of regional gangrene ending in loss of the limb. The local therapy has to be exceedingly cautious. Any irritative agent must be omitted. Dry blood cells, blood-kaolin paste, sulfonamides and antibiotics, the latter in the form either of powders or wet dressings, may be applied. The bandage should be of the protective type applied without tension and with liberal padding.

Intra-arterial injections of penicillin, papaverin[10] and histamine[40,41] have been recommended. The results, however, are equivocal.

In selected cases pinch or Thiersch graft may lead to a temporary or permanent cure.[42]

Prophylaxis is of the utmost importance. Early detection of arterial disease and diabetes, avoidance of trauma and nicotine, and foot hygiene will prevent many losses of limbs.

SUMMARY

The ambulatory and hospital treatment of gravitational ulcers and the value of sulfona-

mides, antibiotics and sympathicolytic drugs are discussed.

The following three types of bandages are described: the pressure, supportive and protective bandage. Their indications are enumerated.

The results of a consequent carried out foam rubber compression therapy with the understanding cooperation of the patient are remarkable.

Ligations of the saphenous and perforating veins and postoperative sclerotherapy have to be undertaken as causative approaches to the problem. The beneficial effect of ligation of the superficial femoral vein in postphlebitic states is not yet proven. The value of skin grafting and local surgery is appraised.

In ulcers due to arterial disease elimination of vasospastic reflexes has to be achieved by interruption of sympathetic pathways either by injection or by operation. The value of etamon and priscoline® is discussed.

The danger of sensitization by the topical use of drugs and antibiotics is also discussed.

The usefulness of vitamins in the therapy of leg ulcers is not established.

Prophylaxis is the most important factor in the therapy of peripheral vascular disease.

Addendum: It was anticipated that cortisone due to its inhibitory effect upon chronic inflammation and connective tissue formation might benefit the healing of stasis ulcers and of indurative postphlebitic cellulitis. Ten to fifteen milligrams of cortone,* diluted with 5 to 20 cc. of ½ per cent solution of novocaine, were injected into the ulcer base and into the surrounding indurated area. Dilution of cortisone apparently did not interfere with its topical activity. Ragan and associates[43] reported an inhibiting effect of cortisone upon wound healing. This apparently applies only to fresh wounds but not to ulcers of long standing. Small doses of cortone did not retard healing. This was observed in a series of four cases, among them one case of inveterate ulcer due to thromboangiitis obliterans. The other three ulcers were of the postphlebitic type. All ulcers which persisted from two to nine months prior to topical cortisone treatment showed signs of accelerated healing; one ulcer was nearly closed after three weeks of cortisone administration. Three other ulcers decreased in size from 20 to 40 per cent up to the time of this writing. Foam rubber compression of the ulcer was an important therapeutic adjuvant. The patients usually complained of soreness during the first day after injection at the site of the infiltration. Injections were given two to three times within three weeks. Besides its mesenchymal activity cortisone produces an active temporary hyperemia at the site of the injection. This might have an additional healing effect. In an experiment cortisone injected intradermally leaves a hyperemic skin wheel which is noticeable up to the third and fourth day after the injection.

* Manufactured by Merck & Co., Inc., Rahway, N. J.

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Modern Operative Technics

TECHNIC OF TRANSABDOMINAL VAGOTOMY

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IN the operation of vagal resection for peptic ulcer the method of approach may have a vital bearing upon both the early and late outcome. In our own cases the transabdominal approach has been employed almost exclusively. the only exceptions being a few in which adhesions or some other pathologic condition precluded an easy access to the nerves through the abdomen. When the transthoracic approach is employed, postoperative pain is often severe, pleural or lung complications frequently develop and the patient's ultimate recovery is thus prolonged. Further, one cannot determine the exact location, nature and extent of the lesion or the existence of any associated disease. By the transabdominal approach, on the other hand, one is not only better able to determine with accuracy the real disease condition but also is able to perform any definitive surgery necessary through the one incision. The technic which we have followed in the transabdominal operation is illustrated and described hereafter.

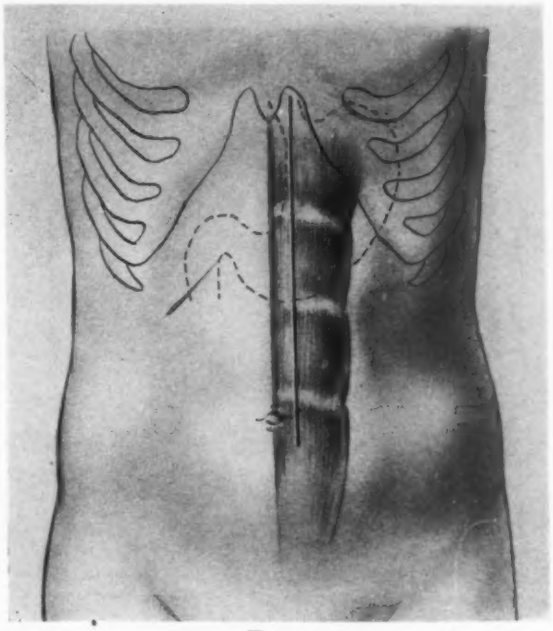
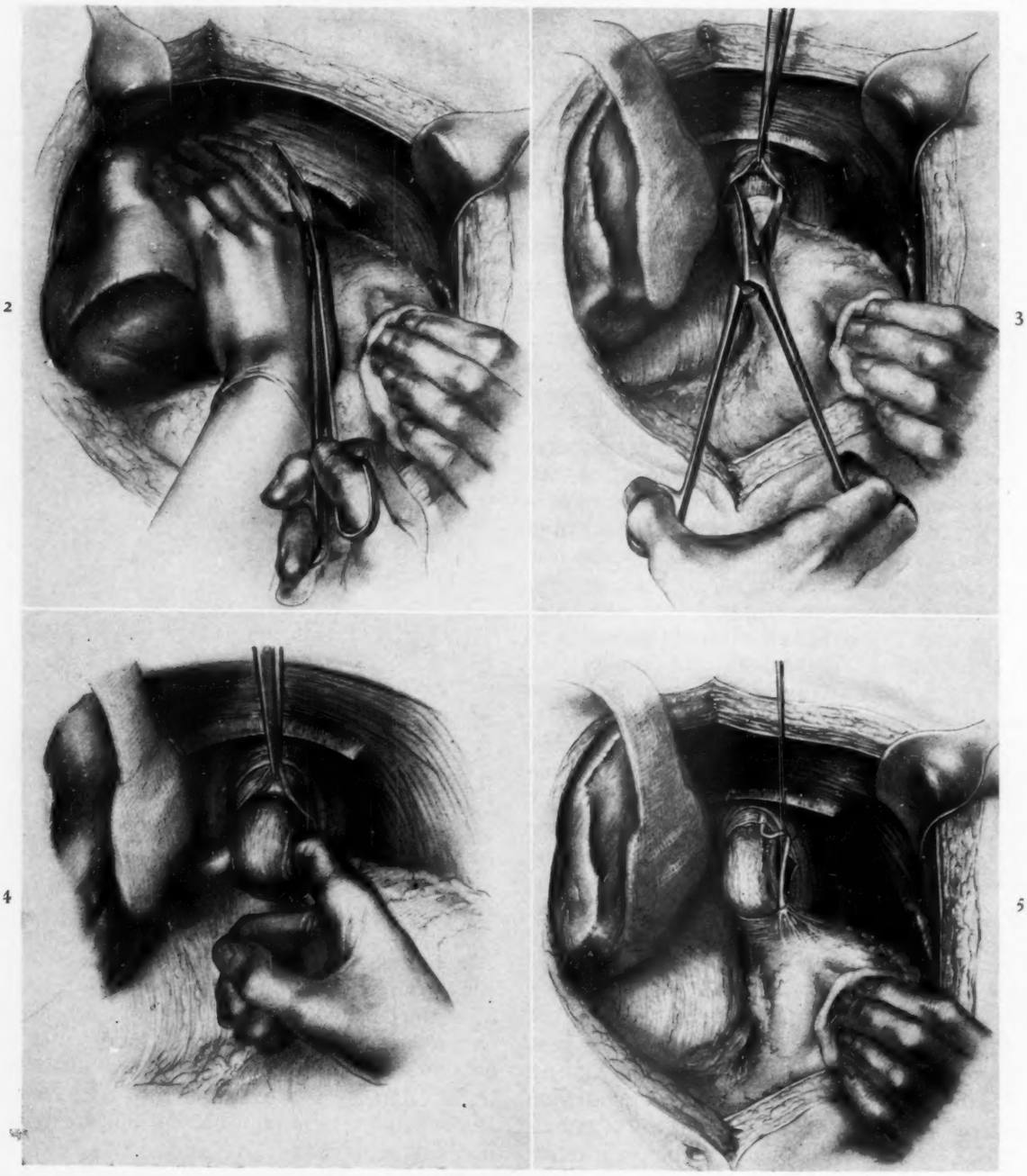


FIG. 1.

Step I. The incision. Various incisions have been used. The upper left paramedian incision extending from the left side of the xiphoid to a little below the umbilicus, separating the left rectus muscle at its inner third, gives the best approach to the subdiaphragmatic space where the esophagus enters the abdomen. A midline incision is satisfactory. Whatever the type employed, its length should be ample to provide complete exposure and insure facility of operation. (Fig. 1.)

Step II. Division of the triangular ligament. The left lobe of the liver is elevated by placing the ligament between the index and middle fingers of the left hand. With gentle traction the ligament becomes sufficiently taut for division by long curved scissors in the right hand. This can easily be accomplished without injury to the diaphragm or to the large vein on the diaphragm which usually lies just above the attachment of the ligament. During the maneuver the stomach is retracted downward and toward the left by the assistant's left hand placed on a moist gauze on the fundus. Undue traction on the stomach should be avoided; otherwise serious damage to the spleen with consequent hemorrhage, possibly requiring splenectomy, may follow. (Fig. 2.)

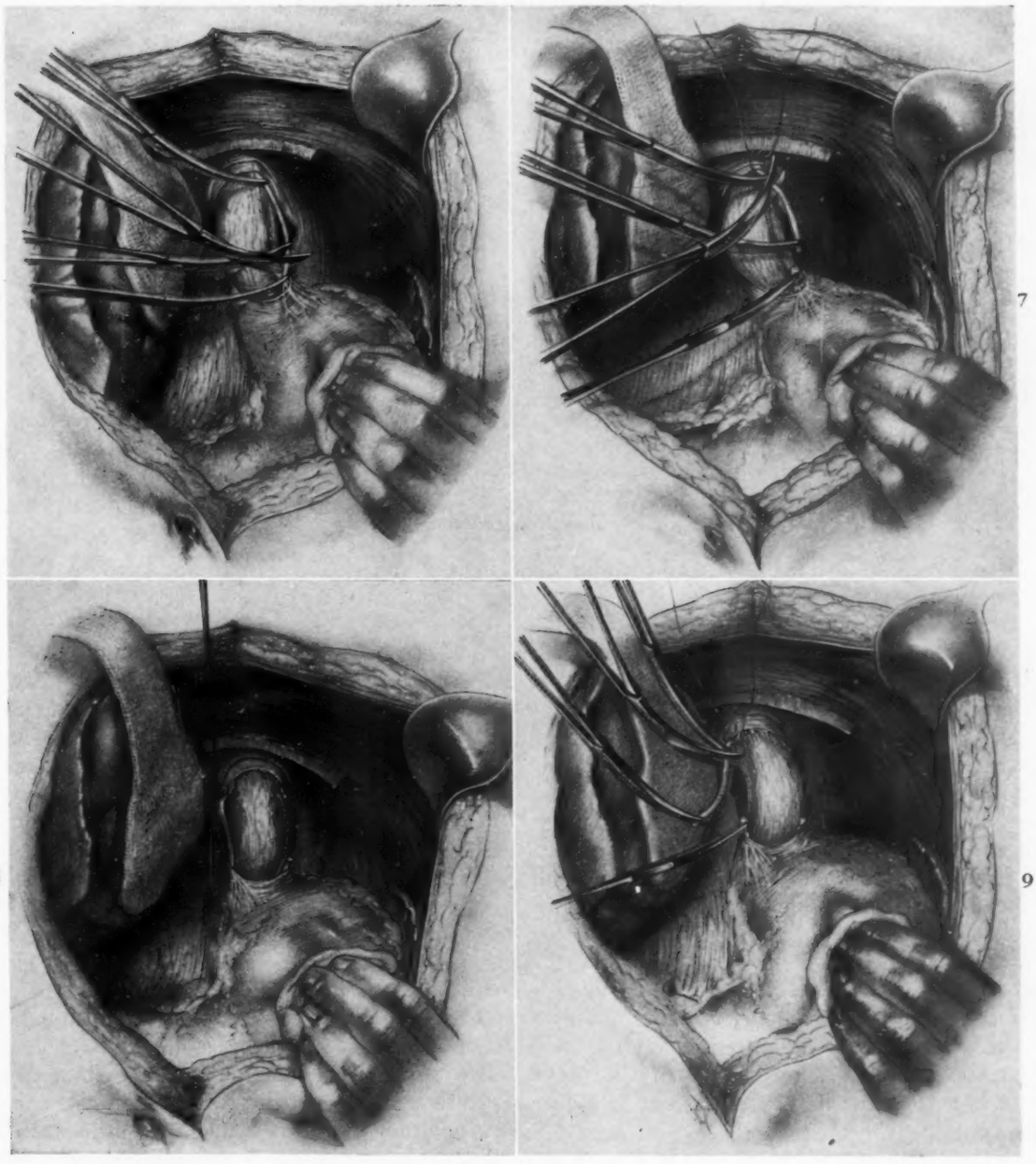
Step III. The triangular ligament has been detached from the diaphragm and the left lobe of the liver retracted to the right and held in that position by a long stocking-covered retractor. While downward traction is maintained on the stomach, a 2-inch transverse incision is next made through the peritoneum in front of the esophagus just above the cardia. With long curved scissors properly spread at the point the fibers of the esophagus are well exposed. This enables the surgeon to lift the upper flap of the



FIGS. 2 to 5.

peritoneum, separating it from the esophagus. The index finger of the right hand is then introduced through this opening and passed upward between the esophagus and peritoneum all the way through the diaphragm into the lower mediastinum. With a gentle rotary motion of the finger the surrounding tissues can easily be separated from the esophagus and vagus nerves. Extreme gentleness is required in the execution of this part of the procedure in order to prevent damage to the esophageal wall and troublesome bleeding. (Fig. 3.)

Step IV. The index finger of the surgeon's right hand has now freed the esophagus from the surrounding tissues for a distance of 2 or 3 inches. The finger is then carefully passed behind the nerves and the esophagus, separating the latter from the aorta and drawing the



FIGS. 6 to 9.

esophagus and the nerves downward through the peritoneal incision. At this point the esophagus and both trunks of the vagi are easily felt by the finger and perfectly visualized. In the vast majority of cases the nerve trunks occupy a constant position on the esophagus. The left, which is the smaller, usually lies along the anterolateral border while the larger right nerve lies along the posterolateral border. Occasionally one may find the right nerve separated from the esophagus by ½ inch or more, or lying behind the esophagus on the aorta. Both nerves are readily identified by the tension which they exert on the examining finger; in contrast to the elasticity of the esophagus, they give the sensation of taut violin strings. Formerly we used a catheter or Penrose type of rubber for traction to hold the esophagus in view during the remainder of the operation; experience has shown, however, that this is not necessary and in addition is often an inconvenience. (Fig. 4.)

10A 10B

FIGS. 10A and 10B.

Step V. A long hook is placed around the left nerve and with gentle traction it is elevated 2 to 2½ inches. At the lower end its branches can be seen spreading out fan-like over the anterior surface of the cardiac end of the stomach. (Fig. 5.)

Step VI. The left nerve, which has been elevated by the hook, is grasped with three long curved forceps. The lowest forceps is placed at the end of the nerve trunk just above the point where it branches. The second forceps is placed ½ inch above this and the third forceps about 2 inches higher on the nerve. The nerve is now ready for division. (Fig. 6.)

Step VII. With long curved scissors the left nerve is divided between the two lower clamps and below the upper clamp, removing a 2-inch segment. The clamps are left on until after the upper and lower ends of the nerve have been ligated; if they are removed before the knots have been tied, the nerves may slip or retract. (Fig. 7.)

Step VIII. The completed resection of a 2-inch segment of the left nerve trunk. The right nerve is being elevated by a long hook. Traction on the trunk usually reveals branches spreading out over the posterior wall of the stomach. Practically always the nerve is easily identified with the index finger, permitting application of the long hook for traction. (Fig. 8.)

Step IX. A 2-inch section is being removed from the right nerve, the lower end having been ligated and the upper end about to be divided and ligated. (Fig. 9.)

Step XA. Here may be seen the ligated ends of both nerves following removal of the segments. The muscular esophageal wall is well exposed. At this stage the surgeon should pass his finger behind the esophagus and carefully examine the space for other nerve trunks or filaments. Simple division of any accessory nerves should be sufficient. If none are found, this completes the resection. (Fig. 10*A*).

Step XB. As the final step in the operation the transverse incision in the peritoneum in front of the esophagus is closed with interrupted sutures of catgut. Some surgeons do not close this incision, believing it unnecessary. In our earlier work this was our practice although in more recent cases we have closed it routinely. The stomach is now returned to its normal position and the retracted left lobe of the liver is replaced. No effort is made to suture the triangular ligament, the liver being allowed to find its natural location. The abdominal incision is closed in layers. (Fig. 10B.)

COMMENT

This paper is concerned only with the technic of vagal resection. The indications for the operation do not enter into the discussion. With experience, however, we have employed it with more discretion and have found that in well selected cases and when properly performed it is an excellent procedure.

Practical Surgical Suggestions

A SIMPLE METHOD FOR REDUCING SHOULDER DISLOCATIONS

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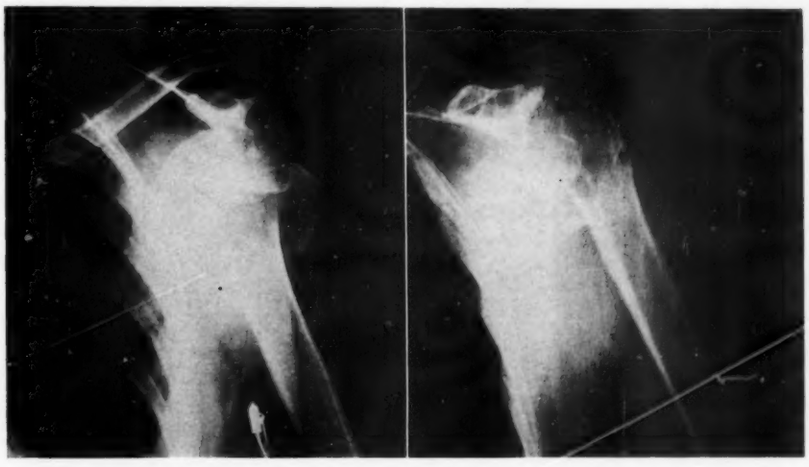
THE primary purpose of this paper is to present a safe, simple and easily mastered method for reducing subglenoid dislocations of the shoulder. It has been the author's privilege to learn the technic from a man who has successfully employed the method for some thirty-three years, Dr. Hubbard T. Buckner. It is nothing new but it is most certainly the simplest method found in a rather extensive review of the literature. No operative procedures concerning shoulder dislocations are discussed in this article.

Many methods of reduction of shoulder dislocations have been advocated. Probably the most publicized and still one which is commonly taught is that advocated by Kocher in 1870. He devised the method after producing dislocations on cadavers. Interestingly enough he worked out the technic after having had personal experience with no less than eleven dislocations.[1,2] Needless to say this method in experienced hands is acceptable, but it most certainly is far from atraumatic and is likewise very dangerous. (Figs. 1 and 2.) As originally described no mention is made of any traction in this technic. It is now generally concluded that some traction is the first step in reducing any subglenoid dislocation. It is interesting to note that no less than forty-six methods have been introduced to correct shoulder dislocations. One is inclined to think, as in the treatment of burns, that whenever there are multiple methods the ultimate in technic has not yet been achieved.



1 2

FIG. 1. Fracture dislocation in elderly woman.
FIG. 2. The humeral head was subsequently rotated and reduction was then impossible.

The exact mode of production of shoulder dislocations has long been debated. The monumental work of Martin[7] has definitely proved the mechanics of subglenoid dislocation. If the upper arm is internally rotated at the end of full abduction, the greater tuberosity of the

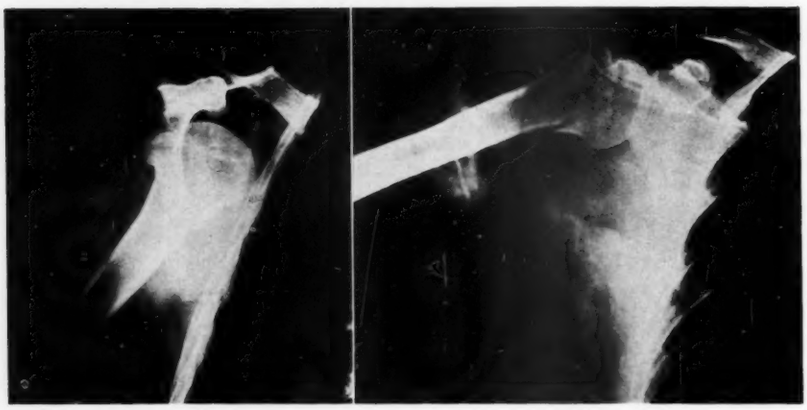


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FIG. 3. Fracture dislocation of humerus with complete head fractures.
FIG. 4. Postoperative film with arm held in abduction cast.

humerus impinges against the undersurface of the acromion of the scapula. If this occurs, the capsule tears and a subglenoid dislocation results. In like manner no scapular rotation occurs with the arm internally rotated due to the torsion produced by the capsule of the joint.

The structures damaged in subglenoid dislocations should be reviewed. In most acute dislocations the capsule is torn in its lower portion. This is due to the greater curvature of the head of the humerus as it is abducted. The long head of the biceps and its sheath are commonly stretched and commonly the rim of the glenoid and greater tuberosity of the humerus are fractured. The head may be displaced enough to cause severe damage to the axillary artery, vein and the cords of the brachial plexus. From its eventually come to rest under the acromion or under the spine of the scapula.

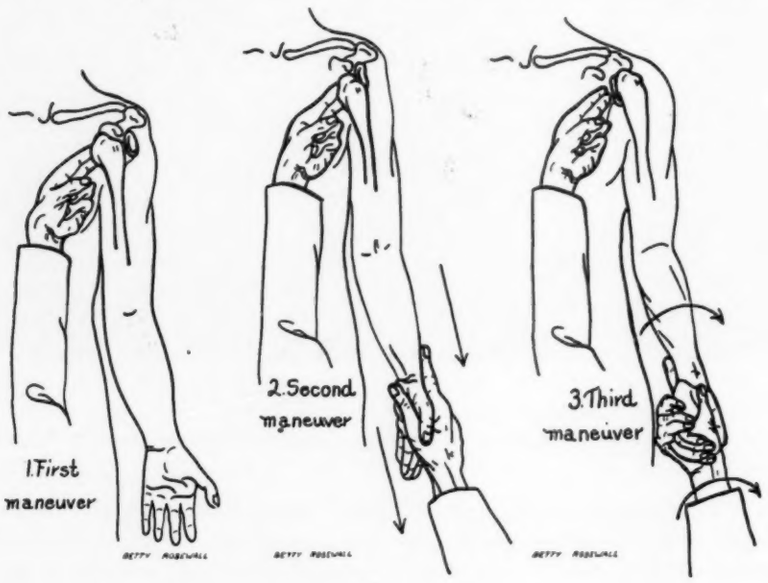

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FIG. 5. Left dislocation; first maneuver.
FIG. 6. Left dislocation; second maneuver.
FIG. 7. Left dislocation; third maneuver.

The position assumed by the head in most (about 90 per cent)[13] of the dislocations is directly in front of the triceps tendon. This is the so-called anterior dislocation of the shoulder. Next, posterior dislocations can occur; they are rare. In this group the head may go out between the teres minor and the triceps tendon and

apparent position the posterior cord is the most commonly damaged. This accounts for the deltoid and extensor paralysis which is so frequently seen. The tendon of the subscapularis and supraspinatus can be and commonly is ruptured in simple anterior dislocations. Fractures completely through the head may occur, and this complication should always be handled very carefully. (Figs. 3 and 4.) Careful observation of good films is most essential. Due to the fact that the brachial plexus is separated from the humeral head only by the subscapulus muscle, nerve lesions must be looked for before and after any reduction of a shoulder dislocation is done.[6] Definite, written physical findings should be entered in the progress record of the patient to prevent malpractice litigation.

The actual technic of reducing dislocated shoulders can now be described in detail. Good x-ray pictures, preferably stereoscopic views, should always be made prior to any attempted reduction. The position of the head can be exactly determined; and if fractures are present, their presence can be evaluated. We firmly believe in absolute relaxation for any type of reduction. Intravenous pentothal® with supplemental curare gives excellent results. For a left-sided dislocation, with the patient on his back on a stretcher or x-ray table, the operator stands facing the patient. The operator's right hand grasps the left hand of the patient and gentle traction is made in a straight line from the shoulder to the hand, with the arm abducted to about 45 degrees. As the traction is directed in a straight line, the arm is not flexed, i.e., the arm is kept parallel with the patient's body. The index and middle fingers of the operator's left hand next palpate the humeral head in the axilla. When this is felt, the head is gently skidded outward and upward at the same time the humerus is gently externally rotated. The head can then be felt and usually heard to move past the inferior border of the glenoid and slip into the shoulder socket. (Figs. 5, 6 and 7.) The elbow is then flexed to a comfortable position with the hand on the chest. The axilla and antecubital fossa are padded and the arm is immobilized against the side with two or three strips of wide adhesive.

CONCLUSION

A review of shoulder dislocations is presented, with a discussion and evaluation of Kocher's method. The mode of production of acute subglenoid dislocations and the structures subsequently damaged are discussed. A safe and very simple technic using traction, external rotation and digital pressure on the displaced head is shown.

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pHISODERM WITH HEXACHLOROPHENE (G-11)*

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IN December, 1949, a report was published concerning the integrity of pHisoderm with hexachlorophene (G-11)† as a surgical scrub material for the operating team. Careful observations were made upon 1,500 consecutive clean cases with a wound infection rate of 1.6 per cent. The protocol of the experiment and the definitions of clean and potentially dirty cases are outlined in some detail in the 1949 report and need not be repeated here. All infections are recorded. Some of the infections are known to be associated with technical error, which possibility could release the guilt from the scrubbing technic. No modification of the figures has been tolerated.

TABLE 1
INFECTIONS IN CLEAN CASES

	No.	Severity of infection			
		Minimal	Mild	Moderate	Severe
Gastric resection	7	.	2	5	..
Gastrojejunostomy, appendectomy	1	..	..	1	..
Cholecystectomy	4	..	4	..	..
Cholecystojejunostomy	1	..	..	1	..
Exploratory laparotomy	2	1	1	..	..
Intestinal obstruction	6	..	5	1	..
Colectomy	1	..	1	..	..
Appendectomy	6	..	2	4	..
Hernioplasty	6	2	1	3	..
Vein ligation	4	1	1	2	
Plastics	4	1	3	..	..
Skin graft	1	1	..	..	..
Biopsy muscle	1	..	1	..	..
Nephrectomy	1	..	..	1	..
Orthopedic procedures	7	2	2	1	2
Neurosurgical procedures	13	2	4	2	5
Totals	65	10	27	21	7

It is the purpose of this communication to report briefly our observations on 5,000 consecutive clean cases. The 1,500 cases of the 1949 report are included in this report—3,500 new clean cases have been added.

Table 1 demonstrates the number of infections according to their severity in practical groupings. There were sixty-five (1.3 per cent) infections in the 5,000 cases. The incidence has remained practically the same as in the previous report (1.6 per cent). Perhaps a more accurately controlled test may be had in the observations upon the 750 hernia cases of this group. In this condition there were six infections, .8 per cent.

COMMENTS

The conditions of the experiment remain practically the same. The operating team personnel has changed so that over 200 different surgeons and nurses have participated. As stated in the previous publication, the scrubbing technic is as follows: Wash hands and arms with pHisoderm and G-11 and water for one minute. Two pushes on container plunger will eject enough material for this purpose (approximately 2 cc.). Rinse with water, then cleanse nails with orange stick. Wash hands and arms with same material and water for two minutes, then rinse with water. No brushes, no antiseptic washing or soaking are necessary. Actual scrubbing time is four minutes. For the worker who scrubs occasionally the time of washing has been elevated to six to eight minutes. There has been less vigorous rinsing with tap water so that a film of the material will remain on the skin. This is accomplished by instructing new operators to rinse sparingly so that the solution observed flowing from the tips of the fingers appears slightly milky in color. At first the oily sensation appears worrisome but it has not interfered with glove placing, dexterity or accuracy of palpation.

Confidence in this material is evident in all surgeons using this scrubbing technic. There

† Supplied through the courtesy of Winthrop-Stearns, Inc.

* From the Surgical Service, Veterans Administration Medical Teaching Group, Kennedy Hospital, Memphis 15, Tenn. Reviewed in the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the author are a result of his own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

have been no incidences of skin irritation that could in any way be attributed to this material.

The concern about the occasional scrubber is pertinent and our observations are made with this in mind. So far, nothing definite is apparent. The majority of infections have occurred from operating teams who operate either daily or from three to five days per week. However, data is not at hand to establish the point accurately.

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CRAWFORD et al. studied the pathology and treatment of the removed cervical stump in 123 women. They encountered endometriosis, cervical fibroids, strictures, polyps, chronic cervical erosions and epidermoid carcinoma. Of greatest surprise to me was the occurrence of seven cases of cancer in this series, an incidence of almost 6 per cent. No wonder the authors believe that total hysterectomy, rather than a simple supravaginal one, should be done whenever a hysterectomy is indicated. It seems justifiable to assert, therefore, that the occasional operator who is able to do a supravaginal operation but not a total hysterectomy should take whatever courses and cadaver surgery is needed to enable him to perform safely total hysterectomies henceforth. (*Richard A. Leonardo, M.D.*)

DESCRIPTION AND USES OF THE BREAST CLAMP*

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THE Adair breast clamp† has been developed and used over a period of twenty years at the Memorial Center for Cancer and Allied Diseases in New York City. It has proved itself to be of great aid in performing the radical mastectomy. The clamp was designed by Dr. Frank E. Adair of the Breast Service.

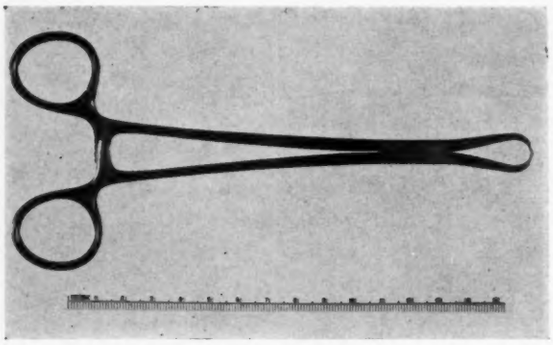

FIG. 1. The breast clamp.

The clamp is approximately 18 cm. long with tenaculum-like jaws, the prongs of which overlap each other by about 3 mm. and are somewhat heavier than are other types of tenacula. (Fig. 1.) It has been made with multiple ratchets for varying tensions of fixation and with a box lock that holds the jaws in alignment.

†Obtained from the United Surgical Supply Co., New York, N. Y.

Primarily, the breast clamps function as retractors for the preparation of thin skin flaps during a radical mastectomy. In addition they serve to hold sterile towels to the wound edge, obviating the handling of skin.

The desired outline of the incision is initially made through the most superficial layer of skin medially and laterally. Skin towels are doubled lengthwise and their folded edge brought to the margins of the flaps. The breast clamps are then applied from the superior to the inferior angles of the incision, spaced about 2.0 to 3.0 cm. apart and arranged so that the prongs pick up only the most superficial layer of the wound edge and a portion of the adjacent towel. In addition a small towel is placed over the breast itself, folded to conform to the edge of the incision and also secured by the Adair breast clamps. As shown in Figure 2 the surgeon creates traction with three or four of the clamps fastened to the edge of the lateral skin flap while

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FIG. 2. The lateral flap dissection is made with traction on the breast clamps, which also hold the towel, and countertraction by the assistant.

FIG. 3. The medial flap is begun with traction vertical to the chest wall and countertraction by the operator, producing a thin flap.

* From the Thoracic Surgical Department, Memorial Center for Cancer and Allied Diseases, New York, N. Y.

the assistant counter-retracts on the lateral side of the breast itself. The dissection is begun at a desired thickness and progresses along the edge for a short distance inward on the flap. These clamps are then dropped and exchanged for the adjacent three or four, and so on, until the entire flap is completed. The medial flap is developed as the breast clamps attached to its edge are retracted in a direction vertical to the chest wall. (Fig. 3.) In the closure of radical mastectomy incisions medial and lateral flaps can be temporarily approximated with the clamps until sutures have been placed.

Besides their use in mastectomies the breast clamps are being used by other services in the hospital where skin flaps are desired, e.g., groin dissections and amputations. They have also been found to be valuable in local breast excisions because the tissue can be grasped firmly and excised with greater control and less crushing than with many of the other instruments commonly used.

To prevent the postoperative onset of thromboembolic disease, many surgeons are now using dicumarol® with success. The use of this oral anticoagulant is especially indicated following major abdominopelvic surgery. Prothrombin activity should be depressed to 40 or 50 per cent of normal in order to obtain suitable prophylaxis and yet avoid serious hemorrhagic sequelae. With administration of this quantity of dicumarol, no liver toxicity (as might be revealed by fibrinogen determinations) was noticed in a recent review of over 3,300 cases. (*Richard A. Leonardo, M.D.*)

Case Reports

SURGICAL ASPECTS OF PRIMARY SPLENIC NEOPLASMS*

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St. Louis, Missouri

PRIMARY neoplasms of the spleen occur infrequently. To exemplify, Krumbhar[1] found four primary malignant splenic neoplasms in 6,500 autopsies, and Lubarsch[2] found three benign cavernous hemangiomas, the most common benign splenic neoplasm, in 19,000 autopsies. One hundred seventy-one primary splenic neoplasms have been reported to the present time[3–13] while thirty-two benign cavernous hemangiomas of the spleen have been reported to 1947.[13]

TABLE I
INCIDENCE OF CLINICAL MANIFESTATIONS

	Total Cases Reported	Clinical Manifestations			
		None (Incidental Findings) (Per cent)	Preterminal or Preoperative Only (Per cent)	Present Previously (Per cent)	Unreported or Unavailable (Per cent)
Benign.	32	53.1	9.4	37.5	0
Malignant.	171	7.3	5.9	61.8	23.9

Clinical interest in these tumors has been generally subjugated to pathologic curiosity due to their relative rarity and to the fact that the first clinical manifestations in the malignant group are often those of impending death. Nevertheless, surgical attempts at cure have been made in 38 per cent of the malignant and 62 per cent of the benign cases. Our interest in this subject having been aroused by a recent case reported herein, we thought that it might be warranted to review the clinical manifestations, surgical mortality and postoperative prognosis of these tumors.

Data relative to the incidence and time of appearance of clinical manifestations of the reported splenic neoplasms are summarized in Table I. Of the malignant lesions, 7.3 per cent produced no manifestations prior to death from other causes. In 5.9 per cent of the cases manifestations appeared just prior to death or to emergency surgical exploration. Of the cases 62.8 per cent presented manifestations for from several weeks to more than a year prior to death or surgical exploration. The only significant early manifestations were pain, splenomegaly and tenderness in the left hypochondrium. The pain usually arose in the left abdomen or flank, often radiated to the scapular tip, and was either intermittent or persistent. Manifestations other than these were those of advanced malignancy elsewhere. Cachexia and anemia when present were often of a precipitant and fulminant nature. It is striking, however, that several fatal cases in which cachexia and anemia were marked showed no remote spread at autopsy. Other late accompaniments not uncommonly present were ascites, left hydrothorax, leukocytosis and a rapidly enlarging spleen. Metastases to remote lymph node bearing areas were infrequent and when present appeared quite late.

TABLE II
DATA ON SURGICALLY TREATED PATIENTS

Surgery			One-year Follow-up		
Splenectomy	Exploration Only	Mortality (Per cent)	Known to be Dead (Per cent)	Known to be Alive (Per cent)	No or Insufficient Follow-up (Per cent)
57	7	21.8	40.6	20.3	39.1

Among the benign tumors 53.1 per cent gave rise to no clinical manifestations, they being incidental postmortem findings. Of this group 37.5 per cent presented manifestations of varying duration at time of first medical consul-

* From the Department of Surgery, The Jewish Hospital of St. Louis, and the Department of Surgery, Washington University School of Medicine, St. Louis, Mo. Aided by the Louis M. Monheimer Memorial Fund.

tation. The predominant presentations were splenomegaly and pain. Occasionally associated were dyspnea, dysphagia, anemia and gastrointestinal symptoms in varying combinations.[14] In 9.4 per cent of this group the first clinical manifestations were those consequent upon intraperitoneal hemorrhage.

A summary of the malignant lesions subjected to surgery is set forth in Table II. It is seen that surgery was performed in sixty-four and splenectomy carried out in 57 per cent of the 171 reported cases. The surgical mortality was 21.8 per cent. Of the patients surviving operation, 40.6 per cent died within the first year, the great majority of recurrence or metastases; and 20.3 per cent were known to be alive at the end of the first year (from the reports it was not possible to ascertain how many of this group harbored malignancy). In 39.1 per cent of the operated group there was either no follow-up or reporting was prior to the end of the first year.

A clinically interesting group among the reported cases of primary splenic neoplasm was that in which massive intraperitoneal hemorrhage occurred following spontaneous rupture of the spleen. The increased incidence of traumatic splenic rupture in the presence of chronic splenic disease, especially malaria and kala-azar, is well known. Occasional instances of spontaneous rupture of a normal spleen have been reported.[14] Spontaneous splenic rupture resulting from thrombosis of the splenic vein secondary to carcinoma of the pancreas has also been reported.[15] The cases of spontaneous rupture occurring in consequence of primary neoplasm are summarized in Table III. Three instances of rupture secondary to benign cavernous hemangiomas have been reported.[16–18] Splenectomy was done in all three of these cases. There was one operative fatality. In none of these cases was there previous symptoms and none presented splenomegaly. While intraperitoneal hemorrhage was massive in each of these cases, clinical evidence of its presence was not sufficient to lead to a diagnosis in any. The clinical manifestations were consequent upon signs of peritoneal irritation. Five instances of spontaneous splenic rupture secondary to primary malignant neoplasms have been reported. Splenectomy was performed in four of these cases,[19–22] with a 50 per cent surgical mortality. In only one of these cases was splenomegaly found and it was in this case only that the clinical evidence of intraperitoneal hemorrhage was sufficiently clear to lead to the correct diagnosis. In the other cases again the manifestations were consequent upon peritoneal irritation. Clinical follow-up was not reported in the two patients that recovered.

TABLE III
CASES OF SPONTANEOUS RUPTURE

	Total Reported	Splenectomy	Operative Deaths	Previous Symptoms	Splenomegaly
Benign.....	3	3	1	0	0
Malignant..	5	4	2	2	1
Total....	8	7	3	2	1

We recently cared for a patient who first presented with a massive intra-abdominal hemorrhage caused by spontaneous rupture of the spleen secondary to neoplasm. The rarity of spontaneous splenic hemorrhage in consequence of neoplasm serves as warranty, we believe, for reporting this case.

CASE REPORT

A man of fifty years was admitted to the hospital on May 3, 1949, complaining of pain and a sensation of fullness in the abdomen. The onset was shortly following a meal thirty-six hours previously and consisted of a sensation of abdominal fullness and moderately severe, constant pain in the upper abdomen and left flank. The symptoms slowly subsided in the next few hours and the patient was able to return to his work. The same symptoms recurred a few hours before hospital admission and had since remained constant. Since the second appearance of symptoms there had been occasional radiation to the right shoulder. There had been no prodromals or previous similar episodes. There had been anorexia since onset but no nausea, vomiting or change in bowel habits. There were no additional complaints at this time. Affirmative facts elicited in the past history were those of mild prostatism, very slight exertional dyspnea and occasional, slight epigastric burning unassociated with food and relieved by alkali. These symp-

FIG. 1. The subcapsular, eroding tumor nodule of the surgically removed spleen.

toms were all of recent years in origin. There was a questionable history of recent, slight weight loss. When seen in the hospital the patient appeared acutely ill, in moderate pain and presented moderate pallor with slight cyanosis of the lips. Oral temperature was 100.2°F. The systolic blood pressure was 110 and the diastolic was 75; pulse rate was 108; respiratory rate was 24. The abdomen was scaphoid and presented a diffuse board-like rigidity. Peristaltic sounds occurred at approximately the same rate as the respirations. The remainder of the physical examination was negative.

Fluoroscopy of the chest was negative. The diaphragms moved freely although a slight lag in the left half was questioned. Roentgenogram of the chest was negative. Roentgenograms of the abdomen in the supine, upright and lateral decubitus positions revealed no intraperitoneal air. The colon was seen to contain a moderate amount of gas and two small gas collections were visualized in small intestinal loops. Urinalysis revealed no abnormalities. The white blood count was 15,000, 8 per cent stab forms, 74 per cent segmented neutrophils. The red blood count was 3,650,000; no gross blood in the stool; blood diastase 325 Somogyi units.

It was considered that this patient harbored an acute intraperitoneal lesion, probably a perforated intestinal viscus, or possibly a perforation of the gallbladder, or rupture of spleen or liver. In considering the latter possibility significant associated hemorrhage was not felt likely. Emergency laparotomy was deemed necessary and, after a short period of preparation, was carried out. About 1,200 cc. of blood were encountered in the abdominal cavity. After its evacuation rapid exploration revealed two abnormalities. The right lobe of the liver presented an irregularly nodular surface which did not strike the surgeon as typical of either cirrhosis or multiple metastases, but it was thought that the lesion was one of the two, probably the former. The spleen was observed to be enmeshed in blood clot; and when this was removed, a point of brisk oozing was seen at the junction of the gastric surface and inferior extremity which surmounted a firm nodular area about 3 cm. in diameter. The point of bleeding was through an erosion rather than a rent of the capsule. Infarct and possibly angioma were considered as the primary lesion. Regardless, the indication for splenectomy was clear, and this procedure was carried out. Although the condition of the patient was satisfactory for the circumstances at this time, the added procedure necessary for liver biopsy was not considered to be in his best interests.

The patient had an uneventful postoperative recovery and was discharged from the hospital on the thirtieth postoperative day. At that time he had not regained his usual physical stamina but was quite active. Hemoglobin had regenerated to 14.5 gm. per 100 cc.

The patient re-entered the hospital sixteen days later presenting marked asthenia and moderate jaundice. This obviously had been a fulminating process. At this time the inferior liver margin was found to be 5 cm. below the costal margin and was quite tender. Roentgenogram of the chest revealed a destructive process in the fifth left rib posteriorly which had penetrated the cortex. The patient deteriorated rapidly and expired on the sixth hospital day. Permission for complete autopsy was not granted but a portion of the right lobe of the liver was obtained.

The spleen weighed 260 gm. and was congenitally bilobed. There was moderate perisplenitis. Several soft, bluish purple nodules, 0.5 to 1.0 cm. in diameter, were scattered over the extent of the organ and were visualized through the capsule. An area of gray-green discoloration was seen occupying the middle third of the diaphragmatic aspect. At the junction of the gastric aspect and inferior extremity there was a 1.5 cm. diameter nodule projecting above the normal surface, and the underlying capsule was punctately eroded in a 0.5 cm. diameter area. (Fig. 1.) Cut section revealed a

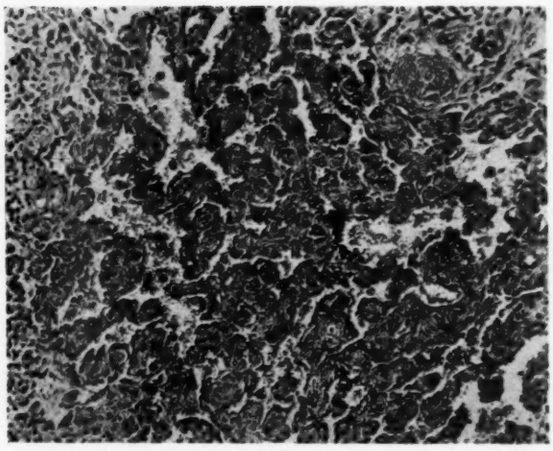

FIG. 2. Area of the splenic tumor presenting interlacing vascular sinusoids. Hematoxylin and eosin, × 100.

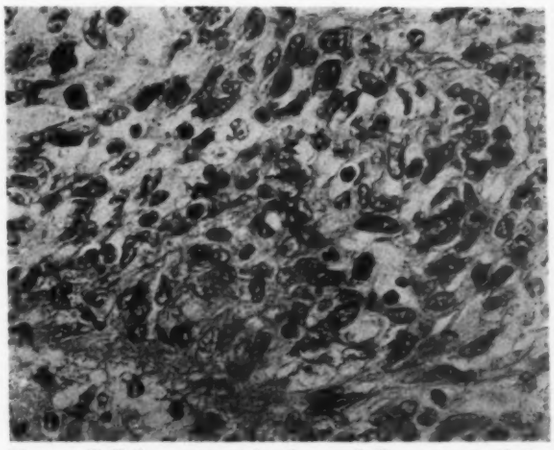

FIG. 3. Cellular pattern in the medullary areas of the splenic tumor. Hematoxylin and eosin, × 450.

well circumscribed collection of dark-clotted blood on a loose vascular background in a 6 cm. diameter area. This area was in the inferior lobe extending toward that portion of the diaphragmatic surface corresponding to the area of gray-green discoloration. Between this lesion and the cortex the brick-red, firm splenic pulp was replaced by a soft, yellow-white, fan-shaped lesion which was partially infiltrated by blood from the subjacent lesion. The 1.5 cm. diameter nodule at the gastric inferior extremity junction was well circumscribed, multilobulated, soft but elastic in consistency and yellow-tan in color except for a mucoid, translucent center. The 0.5 cm. of pulp intervening between this nodule and the overlying, eroded cortex contained several small, hemorrhagic collections. Two well circumscribed lesions, 0.5 cm. in diameter, consisting of collections of dark-clotted blood in a loose framework, were seen in the pulp of the upper lobe.

The histology of the described lesion was that of an angiomatous neoplasm. In areas the process attempted to imitate normal sinusoidal architecture. In these areas only portions showed a cavernous structure while the rest presented an arrangement of small elliptical, interlacing vascular structures, lined by small spindle cells which varied in size and shape. (Fig. 2.) In some areas these cells occurred in sheets, were poorly differentiated and appeared malignant. (Fig. 3.) There was considerable variation in the amounts of hemorrhage and edema occurring in different areas. Necrosis was rare and when present was small in amount. Histologically the lesions were poorly circumscribed, the tumor structures blending into the adjacent splenic parenchyma. Hemosiderin was abundant throughout. The hilar nodule was composed of similar but more compact endothelial-like elements. The splenic architecture showed fibrosis of the pulp and prominent sinusoids which were thickened, dilated and found to contain few round cells and erythrocytes.

Histologic examination of the liver revealed much of the normal architecture replaced by well circumscribed nodules composed of similar tumor to that seen in the spleen, except that here there was less tendency to form vascular channels, and the cells were more elongated and the nuclei smaller and darker. Mitoses were no more frequent. In scattered areas these cells were seen to grow along the sinusoids, forming endothelial-lined blood spaces which were dilated and filled with blood. In some areas there was gross hemorrhage, and small sheets of endothelial-like cells could be seen floating in the matrix. The liver cells adjacent to the tumor nodules were compressed and in some areas replaced by connective tissue.

In our opinion this tumor belongs to the group of splenic hemangiosarcomas which according to Wright[13] are characterized by the presence of well defined, elliptical vascular channels, by areas of sarcomatous appearance and usually by metastases. He collected six cases from the literature which he thought belonged to this group and added a seventh case. As with several of these tumors it cannot be established beyond equivocation that the origin was not multicentric or even hepatic.

COMMENTS

The previously presented data reveal a high surgical mortality and a poor postoperative prognosis in cases of primary splenic malignancies. While precise data were not available in all reports, it is our impression that of the 62.8 per cent of cases who had manifestations of their disease for longer than the immediate preoperative period a significant number had shown these manifestations for a considerable time. Reduction of operative mortality and improvement of prognosis obviously rest upon earlier surgical attack. The signs and symptoms of primary splenic neoplasm are those secondary to splenic enlargement. Earlier surgical intervention would necessarily rest either upon a specific test for splenic malignancy, to be invoked in cases of splenomegaly, or earlier surgical exploration for unexplained splenic enlargement. No elaboration is necessary to qualify further the second alternative. Wright[13] states that an alteration of the hemogram characterizes splenic malignancy. He bases this opinion on five collected cases and one of his own. The altered hemogram is said to resemble pernicious anemia in that anisocytosis, poikilocytosis, polychromasia and occasional nucleated red blood cells with leukopenia and thrombopenia are present. This occurrence is apparently unrelated to the cell type of the tumor, as the observed cases were afflicted with lesions of various histologic variety. This abnormality was not observed in the case we have reported. Benhamou,[9] on the basis of three personally observed cases, stated that the leukocyte count of peripheral blood rises to 16,000 per cm. following administration of adrenalin to patients with primary splenic sarcoma and that unlike the reaction in other diseases with associated splenomegaly this leukocytosis is accompanied with an unaltered differential count. No other specific diagnostic aids were found described in the literature.

SUMMARY

1. The surgical aspects and implications of primary splenic neoplasm, as based on 171 malignant and thirty-two benign lesions collected from the literature, are presented and discussed.

2. A case of hemangiosarcoma of the spleen first becoming manifest by spontaneous splenic rupture is presented.

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PAPILLOMA OF GALLBLADDER

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THIS report is the outcome of discussion with several pathologists and surgeons and a review of the literature with which one is immediately impressed by the different opinions as to the occurrence of papilloma of the gallbladder and the only case reported in a series of 272 gallbladders removed at the Henry Heywood Memorial Hospital (1944 to 1949).

Estimations of its occurrence vary necessarily on the criteria used for diagnosis. Kerr and Leuduin[1] had accepted seven cases up to 1936 and recently added a case reported by Brown and Coppell[2] as acceptable. Irwin and MacCarty[3] reported thirty-five cases in 2,168, C. H. Mayo[4] 107 in 2,583, Shepard and his group forty-two collected cases over a period of thirty-two years. Phillips[7] reported 500 cases of single or multiple papillomas found in a group of gallbladders removed at the Mayo Clinic between 1923 and 1929, and Kirlin[6] reported an incidence of 8 to 5 per cent in more than 17,000 cases over a period of seven years in 1931. Unfortunately, this series showed a definite statistical variation from the report of Phillips[7] which covered the same period.

The best pathologic picture was described by Ringer[15] who stated that the "true papillomas of the gallbladder are a framework of vascular connective tissue covered by a single layer of columnar epithelium. The tumor may be sessile or pedunculated, measuring from 1 to 5 mm. in diameter. Occasionally clear cells containing refractile neutral fat or cholesterol are found in the connective core." The difference between a papillomatous and strawberry gallbladder is a matter of degree. In the former, cholesterol collected in villi to such an extent that papillomas are found. MacCarty[3] states that the strawberry gallbladder is due to lipoid substances within the swollen connective tissue cells which are just beneath the epithelium. When villi become large and branched, they form papillomas. Histologically, such papillomas are identical with villi of strawberry gallbladder; the papillomas are merely larger and branched. Microscopically, single villus of strawberry gallbladder and small papilloma are indistinguishable.

CASE REPORT

Henry Heywood Memorial Hospital No. 66958. M. H. was a seventy-six year old woman who was admitted on April 7, 1947, with the complaint of feeling poorly, having some difficulty with her bowels, nocturia and occasional pain extending to her right shoulder. Physical examination showed marked varicosity of both lower extremities; blood pressure was 160/80 and there was upper right quadrant tenderness which was increased on palpation. No masses were felt. Electrocardiogram on two occasions showed first degree heart block with left ventricular preponderance. Radiographs of lower extremities showed varicose veins without any calcification. Cholecystographs revealed a shadow of the gallbladder within which there was one gallstone. The esophagus, stomach and duodenum appeared normal. There was a pressure defect in the duodenum due to the gallbladder. Preoperative diagnosis was chronic cholecystitis with cholelithiasis. (Figs. 1 and 2.)

The patient was operated upon and exploration of the abdomen revealed many adhesions from the gallbladder to the duodenum and pyloric region of the stomach. Lysis of adhesions revealed a large distended gallbladder with stones. The common duct was distended but no stones were palpable; it was not explored. Gross examination of the mucosal surface showed a papilloma attached by a pedicle. Section showed moderate infiltration of wall with lymphocytes. There was a distinct small papilloma of the mucous membrane but there was no evidence of malignancy. Microscopic examination showed tufts of stroma lined with columnar cells which contained clear lipoid material. The surface epithelium was otherwise negative. The muscular layer showed an increase in fibrous tissue and round cells. The patient was relieved of her symptoms and

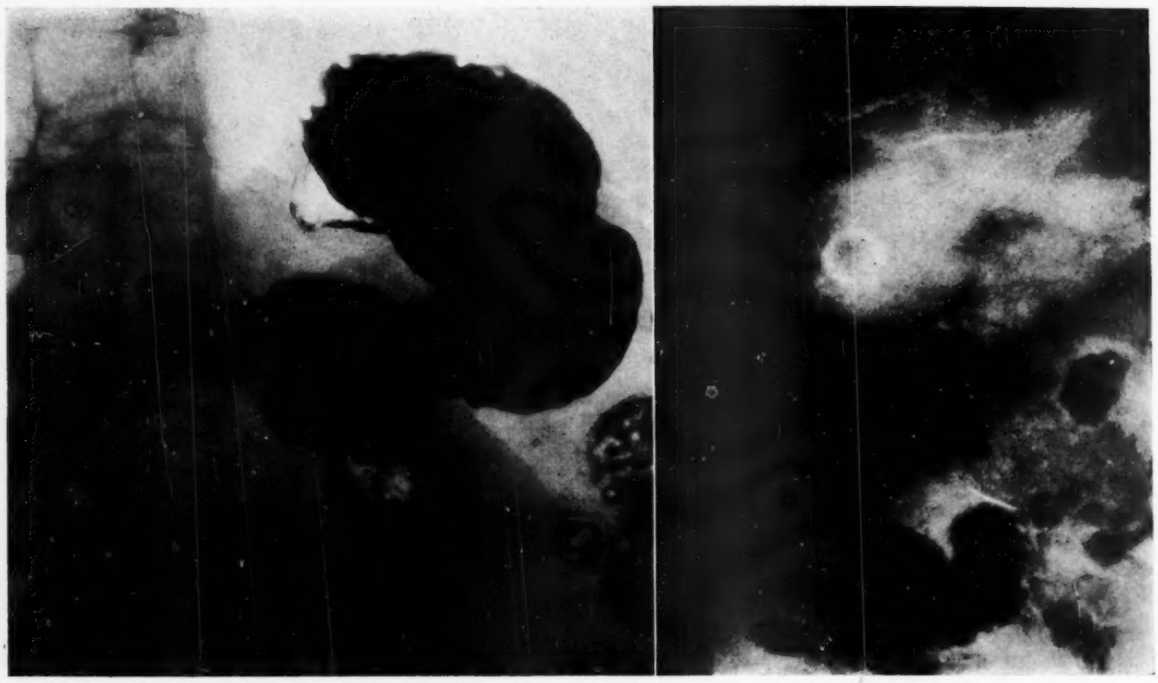

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FIG. 1. Gastrointestinal series, the duodenum appears normal; there is a pressure defect in the duodenum due to the gallbladder.
FIG. 2. A Graham test shows a shadow of the gallbladder within which there is one gallstone.

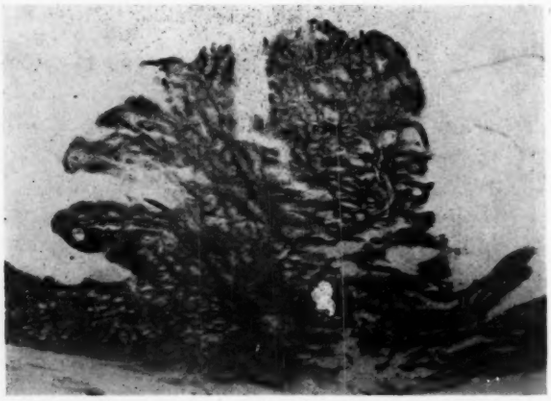

FIG. 3. Microscopic examination shows tufts of stroma lined with columnar cells which contained clear lipoid material; the surface epithelium was otherwise negative. The muscular layer showed an increase in fibrous tissue and round cells.

when last seen December, 1949, had no complaint. (Fig. 3.)

The etiology of these tumors is open to speculation. Phillips[7] in his report found chronic catarrhol cholecystitis associated with papillomas in 51 per cent with strawberry gallbladder in 22.2 per cent and with stones in 15.2 per cent of his cases. In 11.6 per cent of his cases chronic catarrhol cholecystitis was associated with strawberry gallbladder and with stones. There was a total of 33.8 per cent of instances in which chronic catarrhol cholecystitis was associated with strawberry gallbladder and in which deposits of cholesterol were enough and localized in one or more papillomatous formations. In his entire series there were 26.8 per cent associated with stones. It was his impression that infection alone and infection with some as yet unknown metabolic changes resulted in formation of papillomas.

The question of whether papillomas may become malignant is regarded as being problematic. Since, Ringer-Pels-Leusdon-Heuska and Siegert have reported malignant degeneration. In Phillips'[7] series there was one case of carcinoma reported but this case has associated papillomas which gave no evidence of malignant changes.

Kirklin[5] and Sosman[9] state that diagnosis can be made with a high degree of assurance by radiographic examination. The symptoms which usually bring the patient to the doctor are similar to those of chronic cholecystitis. Postoperatively, it has been pointed out by Colp[10] that 30 to 40 per cent of patients have attacks similar to those that preceded operation. In

cases with stones this syndrome was encountered less frequently. Details of cholecystographic technic used may also be found in papers of Kirklin[5] and Sosman.[9]

CONCLUSIONS

The prevalence of papillomas evidently vary with the criteria used in their diagnosis, but it is believed that with newer methods of surgical treatment and preoperative cholecystographic technic in cases that present symptomatology of chronic gallbladder disease the incidence will probably be reported more frequently.

I think that the polyp described here is a true papilloma (rare neoplasm) in which inflammation played a role but quite different from the papillomatous processes encountered in a cholesterolasis of the gallbladder or the strawberry type of gallbladder.

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ESOPHAGEAL FIBROMYOMA ASSOCIATED WITH DIVERTICULUM*

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BENIGN tumors of the esophagus are encountered rarely. In 1933 Patterson found only sixty-two cases in the literature,[1] and by 1943 Adams and Hoover had collected a total of ninety-one reported cases.[2] Moersch and Harrington observed only forty-four benign esophageal tumors among 7,459 necropsies at the Mayo Clinic.[3] In a report from the University of Chicago Schafer and Kittle noted only eleven such tumors in 6,001 postmortem examinations.[4]

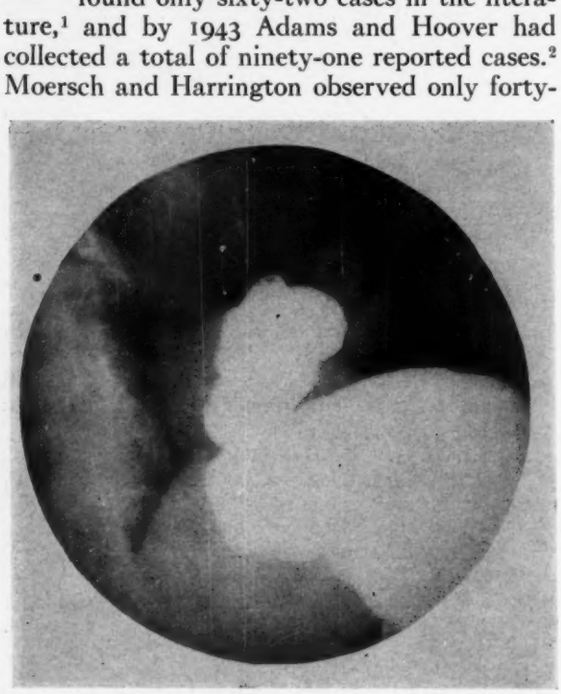

FIG. 1. Roentgenogram of the lower esophagus demonstrating the diverticular pouch with thick walls clearly seen against the pulmonary background.

The case reported here is of special interest because of an associated diverticulum and the lack of symptoms. The tumor was encountered during a routine fluoroscopic and roentgenographic examination of the upper gastrointestinal tract. The only symptom that could be elicited on direct questioning was "occasional epigastric heaviness on overeating." Surgical removal was recommended despite the absence of symptoms and was successfully completed.

CASE REPORT

I. V., a white female, registered nurse, age forty-four, was first examined at the Carle Clinic on April 11, 1949, following an attack of atypical pneumonia. Sydenham's chorea in childhood had left the patient with a residual organic heart murmur though cardiac function had always been excellent. Physical examination revealed a presystolic apical murmur consistent with mitral stenosis and a mild combined dorsolumbar scoliosis. The systolic blood pressure measured 150 and the diastolic, 90 mm. of mercury.

Laboratory studies showed a hemoglobin of 12.6 gm., erythrocytes numbered 4,070,000 and leukocytes 8,350 per cu. mm. of blood with a normal differential count. Kahn and Kline tests were negative; urinalysis was normal. Electrocardiographic tracing showed mild right axis deviation, and the chest roentgenogram was negative except for a cardiothoracic ratio of 13.5:25.5. Cholecystogram revealed a normally functioning gallbladder.

Fluoroscopic and roentgenographic examination of the upper gastrointestinal tract disclosed a large diverticular pouch at the lower end of the esophagus. The walls of this pouch, seen by contrast against the lung tissue, were approximately 2 cm. in thickness. (Fig. 1.) Esophagoscopy supplied no additional information.

On April 29, 1949, a left thoracotomy was done through a left posterolateral approach. The major portion of the ninth rib was resected subperiosteally and the chest entered through the rib bed. Examination of the region of the lower third of the esophagus revealed a firm, somewhat lobulated, lemon-sized mass under the parietal pleura. The pulmonary ligament was sectioned and the pleura incised and re-

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flected. A grayish-yellow tumor mass easily freed from the overlying pleura arose from the anterolateral aspect of the lower third of the esophagus. A pedicle-like structure about 3 cm. in diameter similar to the short stalk of a large bodied mushroom was identified as it entered the firm tumor mass. The stalk proved to be a well-formed diverticulum extending outward and into the central portion of the neoplasm.

The neck of the diverticulum was sectioned about 1 cm. from the esophageal wall. The mucosa was closed transversely with interrupted, fine silk sutures, the knots lying within the esophageal lumen. Mattress sutures of silk inserted in the muscularis reinforced the mucosal suture line. The regional pleura was closed with fine silk sutures. A thoracotomy tube was passed through the tenth interspace in the posterior axillary line for the purpose of temporary underwater drainage of the chest. The thorax was closed satisfactorily by layers using catgut technic. One thousand cc. of citrated whole blood was given by venoclysis during the operation and the patient's condition was good upon leaving surgery.

FIG. 2. The tumor on cut section showing the diverticular stalk surrounded by fibrous tumor tissue.

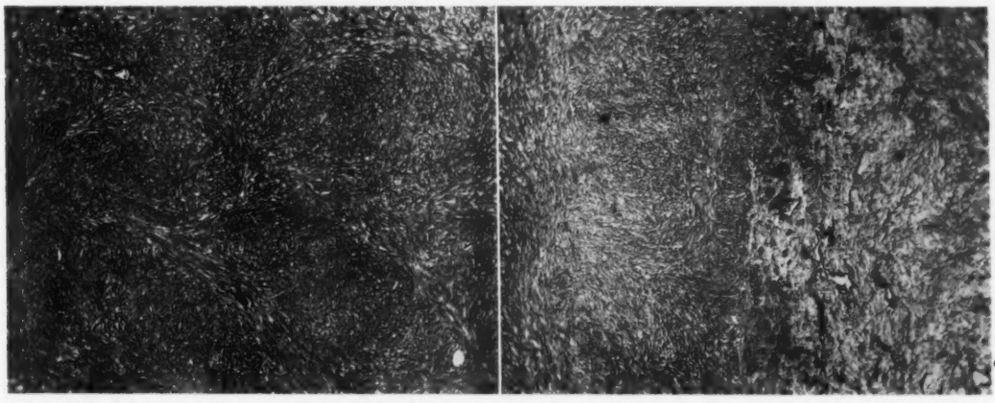

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FIG. 3. Fibromyoma of the esophagus showing the interlacing bundles of muscle fibers separated by fibrous tissue. × 80.

FIG. 4. Esophageal fibromyoma with an area of mucoid degeneration. × 80.

Postoperatively the patient did well. The thoracotomy tube was removed in forty-eight hours. Water and other clear liquids were given by means of an indwelling Levine tube which was removed on the fifth postoperative day when liquids were given orally. The usual early ambulation program was carried out. On the tenth postoperative day the patient was discharged from the hospital on a bland diet; six months later she was asymptomatic and eating a general diet.

The pathologic specimen consisted of a crescentic mass 12 by 3 by 3 cm. in size attached to the esophageal wall by a diverticular pedicle. The cut section showed the diverticulum surrounded by the coarse, white, fibrous tumor. (Fig. 2.)

Microscopically the tumor was composed of interlacing bundles of smooth muscle and connective tissue (Fig. 3) and numerous areas of mucoid degeneration were seen. (Fig. 4.) The tumor was sharply demarcated from surrounding tissues by a vascular fibrous capsule.

COMMENT

Benign tumors of the esophagus can be divided into two general types. The first group comprises those tumors arising from the mucosa and submucosa; the second type arises from the deeper muscular layers and occurs more frequently.

Adams and Hoover noted the most common mucosal tumors to be polyps although papillomas, fibromas, myxofibromas, lipomas, adenomas and cysts may also occur.[2] These mucosal or submucosal tumors grow into the lumen of the esophagus, usually become pedunculated and may cause obstructive symptoms early. Dysphagia is the most common complaint although substernal or epigastric distress, regurgitation and singultus may also be experienced. Bleeding rarely occurs due to the lack of ulceration. When the tumor is attached by a long pedicle, it may be regurgitated into the patient's mouth. Chitty has reported a large esophageal polyp 2 inches in diameter which protruded seven inches beyond the incisor teeth of his patient.[5]

Moersch and Harrington found the myomas to be the most common extramucosal tumors[3] although neurofibromas may also occur in this location. These intramural tumors produce symptoms by their growth into surrounding structures and rarely cause dysphagia. Retrosternal or epigastric distress and intermittent dyspnea and cough are the usual complaints. Silent intramural tumors are not uncommon. Myomas seldom involve the entire circumference of the esophagus and often produce no symptoms until they attain great size.

The association of esophageal diverticulum and benign tumor is decidely uncommon although in 1931 Stewart reported two cases with this unusual combination.[6] To our knowledge coexistence of these two conditions has not been reported again until the present case. It is probable that the diverticulum in our patient resulted from traction of the expanding intramural tumor upon the esophageal mucosa. It is somewhat surprising that this type of traction diverticulum does not occur more frequently.

The diagnosis is usually suspected from the symptomatology and may be confirmed by fluoroscopic and roentgenographic examination of the esophagus when barium is swallowed. Esophagoscopy may result in direct visualization of the tumor, and biopsies may be taken for microscopic study. Bronchoscopy may be indicated when the trachea or bronchi are displaced due to the size or location of the tumor.

Removal of all benign esophageal tumors is advisable. Malignant degeneration in a polyp has been reported[7] and leiomyosarcomas have occurred.[8] Endoscopic removal is the treatment of choice for pedunculated tumors especially those in the upper third of the esophagus. A long tonsil snare may be employed to cut the pedicle and bleeding can be effectively controlled by electrocautery.[9–11] Removal of intramural tumors is usually possible only by cervical or thoracic esophagotomy. Esophageal resection may be necessary whenever growth and distortion are extensive.

SUMMARY

A benign fibromyoma of the lower esophagus associated with a traction diverticulum was found on roentgenologic examination. Despite the absence of any symptoms surgical removal of the tumor and diverticulum was considered advisable and the procedure was carried out uneventfully.

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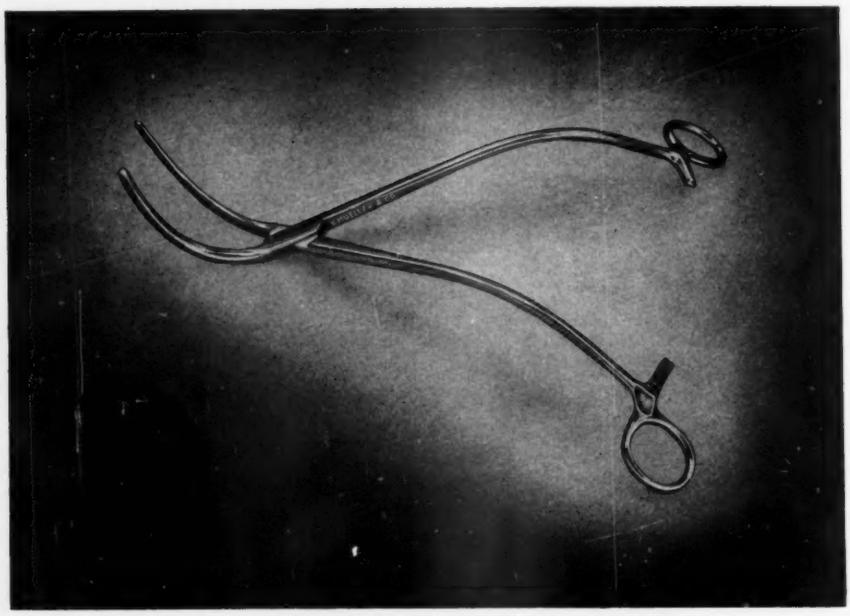

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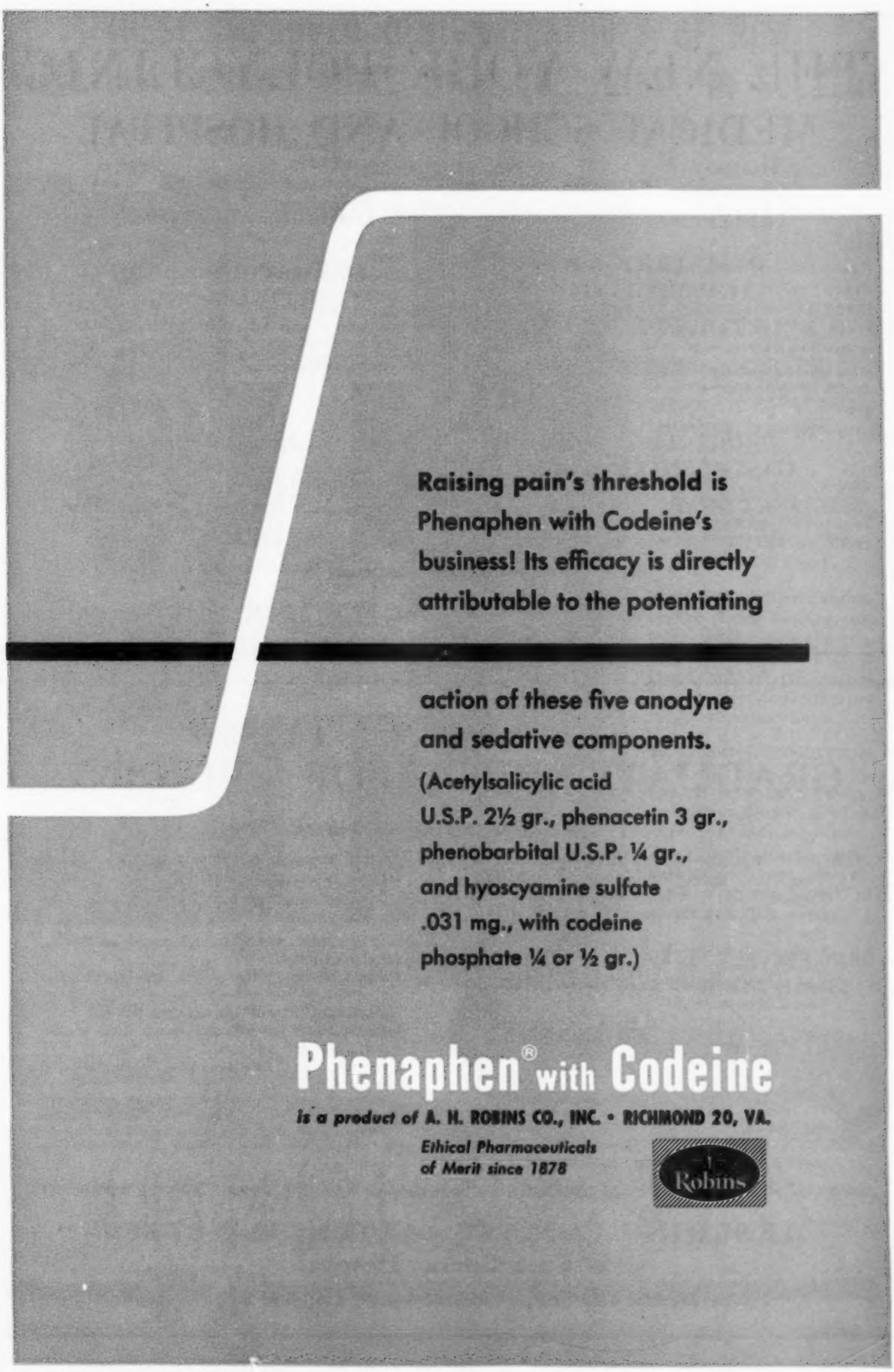
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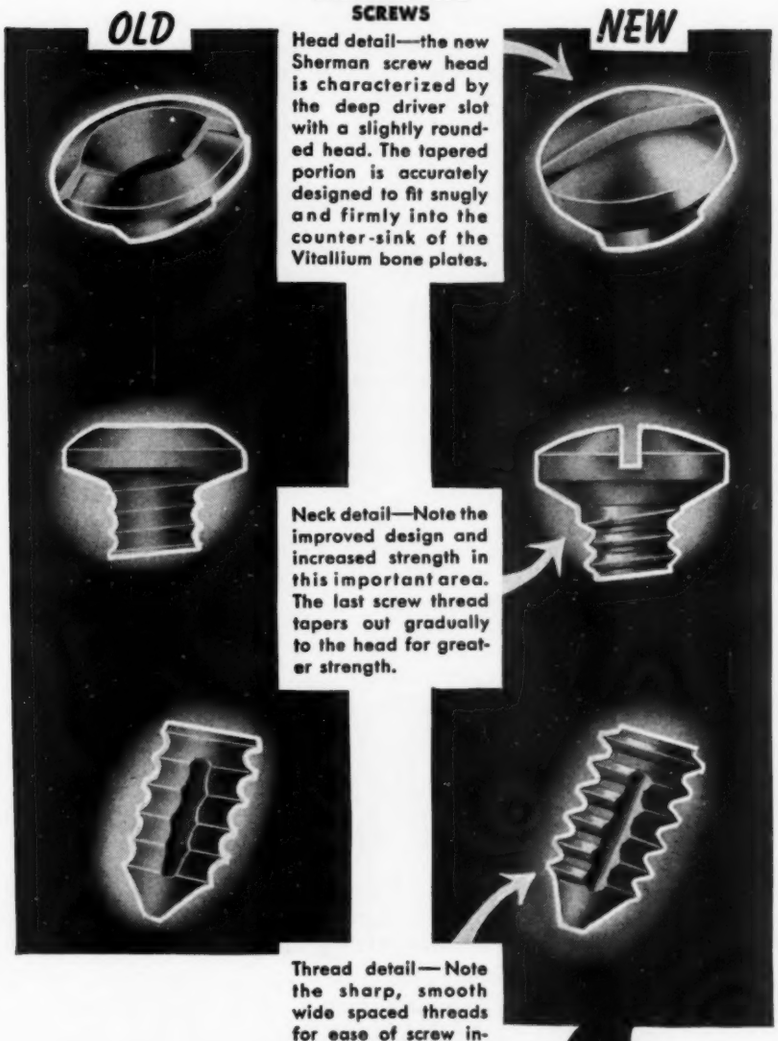

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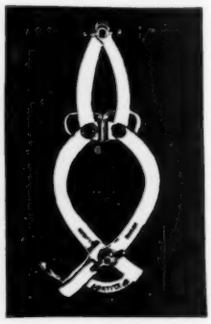

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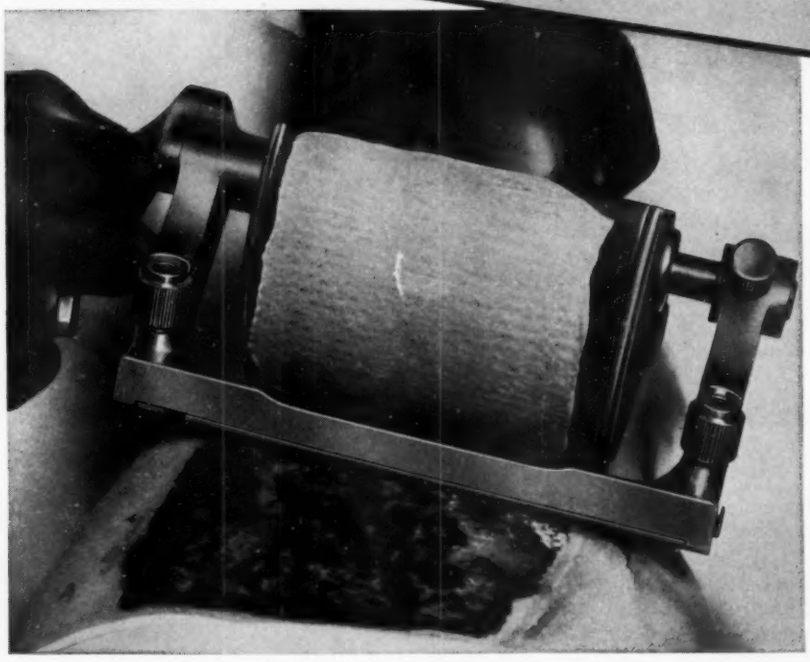

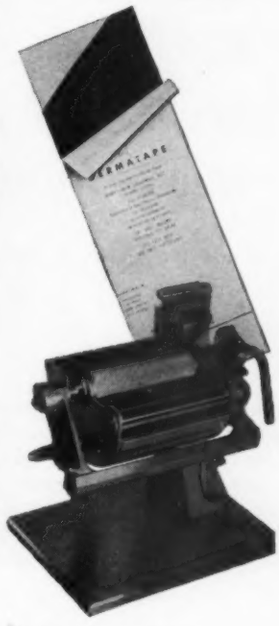

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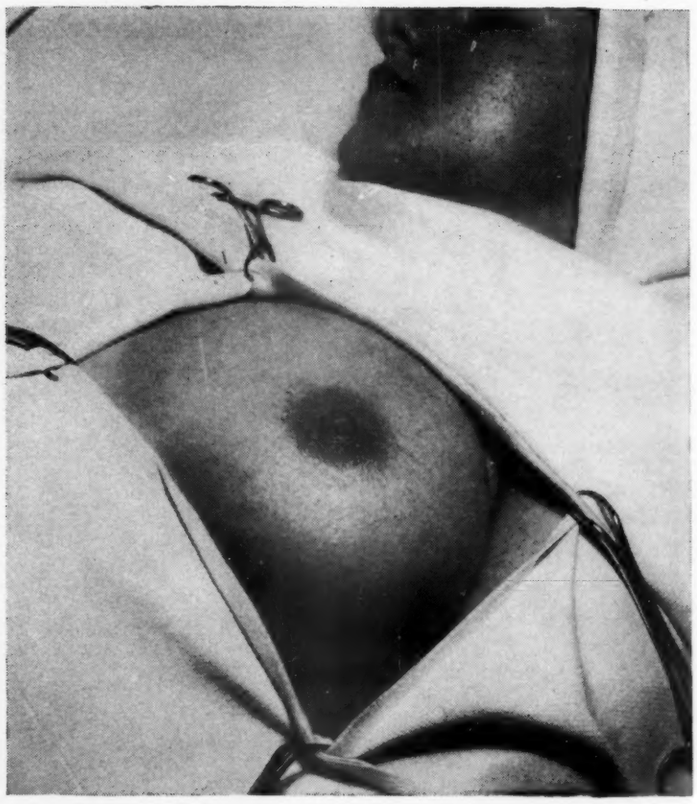

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1. Freeman, B. S., and Young, T. K., Jr.: *Arch. Surg.*, 61:1145, Dec., 1950.

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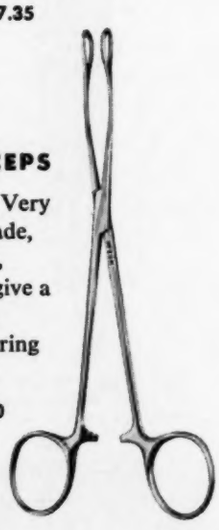

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